TRANSPORT DIRECT

Transport Direct Cycle Planner - Cycle Data Specification

Version 1.0v (Draft)

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Issue Control

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References

Ref	Subject	Title
[MM1]	OS ITN	OS MasterMap Guide
[ITN1]	OS ITN RN	OS MasterMap Integrated Transport Network User Guide http://www.ordnancesurvey.co.uk/oswebsite/products/osmastermap/userguides/docs/OSMM_ITN_userguide_v1.0.pdf
[PN1]	OS PN	OS Pedestrian Network Specification v1.0d (DRAFT)
[DNF1]	DNF	Principles of DNF, http://www.dnf.org/Pages/about%20dnf/
[DNF2]	DNF	Association Model - DNF Documentation Component 2.3.1
[DNF3]	DNF Ids	Unique Object Identifiers DNF Documentation Component 2.1: Identifier Management Technical Guide
[TDP1]	TD Pilot Data model	Transport Direct Cycling Journey Planning Data Model. From pilot TD project.
[CAM1]	Camcycle data model	http://www.camcycle.org.uk/map/route/help/provision/
[OSM1]	OSM	OSM data model including provision for cycling http://wiki.openstreetmap.org/index.php/Map_features
[GDF1]	GDF 3.0	ISO 14825: Geographic Data Files (GDF) - Public Transport… http://www.ertico.com/en/links/links/gdf_-_geographic_data_files.htm
[GDF2]	GDF 3.0	ISO 14825: Geographic Data Files (GDF) - Feature Theme "Services" (POIs) http://www.ertico.com/en/links/links/gdf_-_geographic_data_files.htm
[GML1]	GML	Geography Mark-up Language (version 3.1.1) is described in an Encoding Specification from Open Geospatial Consortium available from http://portal.opengeospatial.org/files/?artifact_id=4700.
[TM1]	Transmodel	http://www.transmodel.org/
[NaPT1]	PT Stop Places	NaPTAN http://www.naptan.org.uk/ National Public Transport Access Node database
[Ifopt1]	PT Stop Places	IFOPT

CONTENTS

1. PURPOSE

This document provides a specification for the data used by the Transport Direct Cycle Journey Planner.

It aims to achieve the following:

- Provide a concise, unambiguous specification that can used to model data for the Transport Direct Cycle Journey Planner.
- Provide a data specification against which data can be collected and sourced. Transport Direct envisage procuring data that meets the specification defined here through a standard tender process.
- Provide a specification against which data sources and data providers can be understood and evaluated. (The Ordnance Survey Integrated Transport Network (ITN) Road Network (RN) is the putative source of road data, and the Ordnance Survey Pedestrian Network (PN) is a source of off-road path data – off-road path data may also be sourced from elsewhere).
- Provide input into the design and development of the Journey Planner.
- Provide input into the design and development of the data collection and maintenance process.
- Provide a specification which is compatible with standards including OS ITN, DNF, GDF, IFOPT, etc.

For brevity, the acronym **CNM** ("Cycle Network model") is used in this document to refer to the conceptual model for cycle data.

The CNM specification is accompanied by a common data exchange file format, CycleNetXChange; this is an XML schema, based closely on the ITN schema for the road network, that provides a concrete implementation of the model described in this document. There will be an agreed XML exchange process to ensure data is sourced and collected to a compatible standard. The XML schema reuses GML & ITN subschema packages wherever possible. This allows data management tools and processes to be developed, making the data collection, maintenance and management tasks easier.

Note that the term 'Standard' is used in this document in the wider sense of an agreed de facto specification rather than that of a formal CEN or ISO specification.

The CNM itself is a quite simple model (See Figure 7-1 on page 38); all its main features it can be described on a diagram on single page – see Figure 7-2 on page 40) – and its approximately 50 cycling related attributes (see Section 9 and Table 15-1), most of which are optional. To make use of it, however, one must understand the underlying Road and Path network models, and so much of the bulk of this document is concerned with presenting a summary of these models (taken from OS ITN RN & PN) in order to provide a context for the CNM itself.

The full CNM specification includes an amount of technical material which requires the reader to have some understanding of UML and data modelling. A non technical reader may get nonetheless gain a good understanding of the CNM specification by reading sections 4 (*Use Cases),* 5 (*Assumptions & Processes*) and 6 (*Examples*), supplemented with an approximate reading of sections 9.1 (*Attributes*) and 10 (*Data Capture rules*) to check coverage of specific data elements.

This version of the document is marked as draft indicating that some final details of the CNM might be revised as the model and schema are is used. Transport Direct welcomes feedback on the CNM.

2. BACKGROUND

This specification has been informed from the outputs of the Transport Direct Cycle Journey Planner Pilot and collaborative discussions with the following:

- Atkins
- Cambridge Cycle Campaign Network
- Camden Consultancy Services
- Cycle City Guides
- Cycle England
- CTC
- Kizoom
- Ito World
- Ordnance Survey
- TfL

We thank Chris Gibbard (DfT), Colin Henderson (OS), David Kirton (Camden), Peter Miller (ITO), Simon Nuttall (Cambridge Cycle Campaign), Richard Shaw (Atkins), Jonathan Shewell-Cooper (Atos Origin), Shane Snow (DfT), for their contribution to this specification.

3. TERMINOLOGY & GENERAL DESIGN PRINCIPLES

This CNM specification adopts where possible the terminology and approach defined in existing mainstream standards. The base standards of primary relevance for GIS data in the UK level are the Ordnance Survey's Integrated Transport Network (ITN) Road Network (RN) & Pedestrian Network (PN) schemas, and more widely the ISO Geographic Mark-up Language Files (GML) and Geographic Data Files (GDF) standards. GML and GDF provide a representation of map features and are similar and compatible with the data model adopted by the Ordnance Survey ITN (whose schema uses GML). Where GDF and GML/OS ITN differ, we use ITN terms but note the GDF ones (see Table in Section 11).

The standard GIS models use an entity relational representation that characterises data as one of three types of component:

- **Features**: Defining the Real World entities such as Roads and Rivers.
- **Attributes**: Defining the characteristics of features and relationships as atomic properties of well defined data types.
- **Relationships**: Defining the associations, and or sub-typing relations between features.

3.1. DNF Digital National Framework

The OS ITN RN & PN systems are part of the Digital National Framework (DNF), which sets out common principles for the efficient design of large data sets so that they can be managed and combined usefully and in particular, be fused with GIS data. The CNM will similarly uphold DNF principles, including

- The concept and methods shall be driven by the strategic needs of the wider GI community and the needs of the information industry – including, in CNM's case, the various Cycling stakeholders.
- Data should be collected only once and then re-used.
- Base reference data should be captured at the highest resolution whenever economically possible.
- Information following capture may, where appropriate, be used to meet analysis and multi-resolution publishing requirements.
- DNF will incorporate and adopt existing de facto and de jure standards, wherever they are proven and robust.
- Data should be designed for evolution, and include versioning and management metadata.
- Data should allow for "deltas" - or in OS terminology, "Change Only Updates" (COU.)

3.2. Transmodel

The UK's Digital National Framework (DNF) follows recognized principles of informational science, to separate the different concerns needed for an efficient representation:

Similar principles, specifically applied to representations of transport networks, are found in the CEN Transmodel standard, a general abstract model for describing public transport information systems (and whose terminology and concepts for PT features are used in GML and GDF). The proposed CNM is organised in a similar manner to Transmodel to separate concerns according to recognized principles of informational science, including:

1. **Layered Semantic Models**: The efficient modelling of transport information requires a number of distinct models, representing different levels of discourse. For example, (i) the geospatial location (i.e. map) layer, (ii) the network topology layer, (iii) the service pattern or route layer, (iv) the timed vehicle journey layer, etc.

2. **Projection**: It should be possibly to combine the different models in order to compute over them, relating the corresponding elements of different levels of discourse precisely and unambiguously, using a common frame of reference. For example, route links should map onto geospatial objects such as roads; timing links should map onto route links, etc. The establishment of equivalences between distinct model layers is termed *projection*.

3. **Common Terminology:** A standard set of common conceptual entities should be used for the elements making up the models at each different layer. For example Road Link, Path Link, Passenger Trip, etc. Terms whose semantic space in colloquial use may cover multiple related concepts will be restricted to one specific concept when used as a technical term. For example, “trip” will be reserved for a traveller, “journey” for a vehicle.

4. **Point and Link Structures**: Transport Information System models typically involve complex networks which are modelled in computer systems by graphs; that is, as networks of nodes (points) and edges (links). Depending on the information of interest in a particular application, it may be appropriate to use ordered collections of links, ordered collections of points, or combinations thereof. Links of a given type should only connect to points of the corresponding semantic level of discourse.

5. **Well-defined Data Reference Systems**. Elements corresponding to external entities should be assigned unique identifiers from agreed data reference systems.

3.3. CNM Adherence to DNF

The above principles are reflected in practice as follows:

- By the reuse of the ITN RN & PN networks.
- By the reuse of Geometry from the ITN RN & PN networks rather than requiring a separate geometry for the Cycle network
- By the assignment of unique object references to DNF Reference Objects – such as the ITN road network elements that may then be referenced by other DNF from Business objects
- By the use of a managed lifecycle of elements: identifiers are not reused and all elements are versioned.
- By the use of explicit metadata for Community Rights.
- By the reuse of GML elements within the XML schema.

3.4. Abbreviations

Term	Definition
CNM	Cycle Network Model
COU	Change Only Update (ITN)
DDL	Data Definition Language
DNF	Digital National Framework
GDF	Geographic Data Files
GIS	Geographical Information System
GML	Geographical Mark-up Language
IFOPT	Identification of Fixed Objects in Public Transport
ITN	Integrated Transport Network (Ordnance Survey)
IPR	Intellectual Property Rights
NaPTAN	National Public Transport Access Node database
OS	Ordnance Survey
PN	Pedestrian Network (ITN)
POU	Public Open Space (ITN)
PRI	Path Routing Information (ITN)
RN	Road Network (ITN)
RRI	Road Routing Information (ITN)
TOID	Topographic Identifier (ITN)

3.5. Glossary of Terms

This glossary includes definitions of certain key terms. Where a term is taken from another base standard, this is indicated on the term heading. For a fuller glossary of OS terms see [ITN1] and [PN1].

Access Link - PN

A link between an ACCESS NODE and a FUNCTIONAL SITE to indicate that the site may be reached from the point of access.

ACCESS LINKs may have GEOMETRY but it is not part of CNM.

This definition of an ACCESS LINK is consistent with ITN which is different to the Transmodel concept of an ACCESS LINK. The IFOPT ACCESS PATH LINK or STOP PATH LINK corresponds to the ITN/CNM ACCESS LINK

Access Node - PN

The point of entrance to a building, Public Open Space, etc, to which links from other networks, e.g. the Path or Road network, may be joined.

Access Type - PN

The nature of access to a Feature: may be public, private unrestricted, or private restricted.

Aggregated Way – GDF, CNM

A collection of NETWORK elements with a common name, used to define Cycle routes as named paths. May have discontinuities and branches.

Connecting Link - PN

A type of link used to associate nodes of two different networks, for example a ROAD NODE and a PATH NODE. A CONNECTING NODE is used to link the end of the CONNECTING LINK with a ROAD or PATH NODE. A connecting link has no GEOMETRY.

NB CONNECTING LINKs are distinct from CONNECTION LINKs, a Transmodel concept for specifying that interchanges may be made between two STOP POINTs.

Connecting Node - PN

A node of a CONNECTING LINK used to indicate the point of connection between two networks.

A CONNECTING NODE may reference a PATH NODE, ROAD NODE, or ACCESS NODE. It may also specify a distance along the link of the referenced node at which the connecting link is located.

Connection Link - Transmodel

The physical (spatial) possibility for a passenger to change from one public transport vehicle to another to continue the trip. Different times may be necessary to cover this link, depending on the kind of passenger.

Community Rights - CNM

A description of the source, ownership and IPR of an element.

Contributor - CNM

An individual or organisation providing data under a common originating DNF prefix and identified in the COMMUNITY RIGHTs.

Contributor Organisation - CNM

An organisation providing data under a common originating DNF prefix.

Cyclable Link - CNM

A linear section for cycle movement. In the CLM it is represented by either a ROAD LINK or PATH LINK with the further attribution of cycling properties.

Cyclable Node - CNM

A feature with point GEOMETRY that may be used by a cyclist. In the CLM it is represented by either a ROAD NODE or PATH NODE with the further attribution of cycling properties.

Cyclability - CNM

The overall suitability of a route for cycling.

Cycle Functional Site - CNM

A type of FUNCTIONAL SITE offering cycle related SERVICEs. May be used to define Cycle parking at a fixed location along a PATH or ROAD LINK, or a cycle shop; a retail outlet offering Cycle hire, cycle repair services, or where cycles or cycle parts may be purchased.

Cycle Network - CNM

A PATH or NETWORK that includes cycling attributes.

Can be assigned COMMUNITY RIGHTS to apply by default to all elements in the network.

Cycling Manoeuvrability - CNM

A specification of the suitability of a transition at a junction of a path or road network from an incoming link to an outgoing link for cyclists.

Cycle Trip Planner - CNM

A journey planning engine that searches a set of network links and nodes between two points to find a Trip plan optimized for cyclists. May support preferences for different types of optimization and weightings for the optimization, such as “shortest”, “safest”, “cleanest”, etc.

Date Time Qualifier - ITN

A set of properties that specify the temporal constraints on use of a link or partial link that are relevant for consideration by routing engines, for example, on which days of the week or time-bands routing constraints apply. A Type of QUALIFIER.

Directed Node - ITN

Used to represent an association between a FEATURE LINK and a FEATURE NODE in a particular direction. A DIRECTED may also have properties of its own such as a GRADE SEPARATION.

A DIRECTED NODE may only be used to connect nodes of the same type, thus a DIRECTED ROAD NODE connects ROAD NODEs, a DIRECTED PATH NODE connects PATH NODEs, etc.

Direction of Traffic Flow - CNM

The direction in which Traffic of a particular mode (e.g. bus, car, freight lorry, cycle pedestrian) is allowed to proceed along a FEATURE LINK. There may be different flow direction for different modes.

Direction of flow of road traffic can be specified by INSTRUCTION attribute on an ENVIRONMENTAL Qualifier of a LINK, PARTIAL LINK, ROUTE or PARTIAL ROUTE INFORMATION ELEMENT.

Direction of flow in an individual lane may be specified on a LANE QUALIFIER of a LANE INFORMATION element.

DNF prefix - DNF

Framework of reference made up of DNF REFERENCE OBJECTs which occupy the area of interest and to which Application Reference Objects and Business Objects may be related.

DNF Reference Base - DNF

Framework of reference made up of DNF REFERENCE OBJECTs which occupy the area of interest and to which Application Reference Objects and Business Objects may be related.

DNF Reference Object - DNF

GEOGRAPHIC OBJECT that forms part of the DNF Reference Base which may be referenced by other objects. A DNF Reference Object can only be represented by one GEOMETRY in the DNF context.

Environmental Qualifier - ITN

A set of properties that specify the environmental constraints on use of a link or partial link that are relevant for consideration by routing engines, for example, whether use of a road section it is one way.

A QUALIFIER is associated with node, link or partial link using a ROAD or PATH ROUTING INFORMATION. Multiple qualifiers may be applied to compose complex conditions, for example, that a route can be used in a particular direction (from an ENVIRONMENTAL QUALIFIER) by particular types of vehicles (from a VEHICLE QUALIFIER) at a particular time of day (from a DATE TIME QUALIFIER).

Feature - GDF

A software entity representing a Real world entity that can be projected with a cartographic context. Will normally have GEOMETRY. Can be consistently referenced according to DNF principles by a unique identifier, a TOID.

Feature Alias- CNM

An alternative identifier that can be associated with a FEATURE to indicate its derivation if it processed and renumbered by an aggregator. This allows its original identity to be re-established on round trip exchange with the original supplier.

Feature Link (Abstract) - CNM

A link of a network, such as a ROAD LINK, PATH LINK, or ACCESS LINK (ITN), that is a managed FEATURE and that has GEOMETRY and also possibly ROUTING INFORMATION.

A FEATURE LINK is an ABSTRACT SUPERTYPE: it specifies common properties of different concrete link types, but does not exist as a concrete element in its own right.

Feature Node (Abstract) - CNM

A node of network, such as a ROAD NODE, PATH NODE, or ACCESS NODE that is a managed feature and has a GEOMETRY and also possibly ROUTING INFORMATION.

A FEATURE Node is an ABSTRACT SUPERTYPE: it specifies common properties of different concrete node types, but does not exist as a concrete element in its own right.

Functional Site - PN

A named place that may be linked to a ROAD or PATH NETWORK. May have one or more ACCESS NODEs.

Geographic Object - DNF

Abstraction or application view of a real world object which has a fixed and identifiable location on the Earth's surface.

Grade Separation - ITN

A difference in the physical level of two FEATUREs, marked on a DIRECTED NODE, that means a Vehicle cannot necessarily transit the link.

Individual Contributor - CNM

An individual person or organisation providing data and identified in the COMMUNITY RIGHTs.

Lane - CNM

A subdivision of the road carriageway or a pathway unto one or more parallel sections that may have specific individual attributes and ROUTING INFORMATION.

Lane Information - CNM

A grouping of one or more LANEs of the road carriageway or a pathway for which ROUTING INFORMATION can be specified in the from of one or more QUALIFIER, including LANE QUALIFIERs, PATH ADVISORY QUALIFIERs, and DATE TIME QUALIFIERs.

Lane Qualifier - CNM

A set of properties that specify the constraints on use of LANEs within of a ROAD LINK or PATH LINK or partial link that are relevant for consideration by routing engines, for example whether there is a dedicated bus lane.

A Qualifier is associated with node, link or partial link using a ROAD or PATH ROUTING INFORMATION. Multiple QUALIFIERs of the same or different types may be applied to compose complex conditions,

Manoeuvre - GDF

A transition at a junction of a PATH or ROAD NETWORK from an incoming link to an outgoing link. The allowed MANOEUVRE may be subject to restrictions or rating for suitability.

IN the CNM MANOEUVREs are specified using ROUTING INFORMATION elements and a CYCLING MANOEUVRABILITY instance.

Named Contributor - CNM

A contributor, either a INDIVIDUAL CONTRIBUTOR or an NAMED ORGANISATION providing data and identified in the COMMUNITY RIGHTs

Navigation Path - IFOPT

A sequence of traversal of PATH LINKs or ROAD LINKs needed to perform a trip between an origin and destination. May be computed dynamically or created statically.

Network Member - ITN

An element of a network, such as a ROAD LINK, PATH LINK, or a ROAD NODE, or PATH NODE. NETWORK MEMBERs may share common properties, such as the ability to be assigned to an AGGREGREGATED WAY.

Objective Attribute - CNM

A property of a FEATURE that can be described with objective criteria that can be independently verified to always get a consistent result, and which may be provided by professional surveys such as the OS. For example, whether a street is one way.

Offset Path Link - CNM

A type of PATH LINK whose GEOMETRY is specified relative to another PATH LINK or ROAD LINK. It is assumed to follow the other link at a specified translation

An Offset PATH LINK is a type of FEATURE LINK.

Offset Path Node - CNM

A type of PATH NODE whose GEOMETRY is specified relative to another PATH NODE or ROAD NODE An Offset PATH NODE is a type of FEATURE NODE.

Path Advisory Qualifier - CNM

A set of properties that specify the subjective attributes of a ROAD LINK, PATH LINK or PARTIAL LINK which are relevant for consideration by routing engines, including on the CYCLABILITY for example whether it is an “easy” route.

A QUALIFIER is associated with a node, link or partial link using a ROAD or PATH ROUTING INFORMATION. Multiple qualifiers of the same or different types may be applied to compose complex conditions.

Path Link - PN

A linear section for pedestrian, cycle or horseback movement. By definition this is not part of the ROAD NETWORK: it belongs to the PATH NETWORK.

A PATH LINK is a type of FEATURE LINK.

Path Link Information - PN

Information that may influence the choice of route that applies to a single PATH LINK in any direction of travel. Such information may apply to an entire PATH LINK or relate to just a point along the PATH LINK.

For example, a crossing may be associated with a path by use of a PATH LINK INFORMATION that specifies the location of an ENVIRONMENTAL QUALIFIER.

Path Network - CNM

A versioned set of PATH LINKs and PATH NODEs describing the pedestrian, cycle or horseback paths. The Path Network is distinct from the Road Network.

Can be assigned default COMMUNITY RIGHTS to apply to all network elements within the network that do not specifically override the default values.

Path Node - PN

A FEATURE with point GEOMETRY that bounds a PATH LINK.

Path Partial Link Information - CNM

Information that may influence the choice of route that applies to a portion of a single PATH LINK in any direction of travel.

Path Route Information - CNM

Information that may influence the choice of route that applies to one ore more PATH LINK features in a specified direction of travel.

Pedestrian Network - PN

The OS Term for the network of footpaths, bridleways and other path ways for out of car users that is described by the ITN Pedestrian Network Specification.

In the CNM, a PATH NETWORK element is introduced to explicitly represent a set of paths that make up a network.

Place - Transmodel

A geographic place of any type which may be specified as the origin or destination of a trip. A PLACE may be of dimension 0 (a POINT), 1 (a road section) or 2 (a ZONE).

PT Trip - Transmodel

A part of a trip starting from the first boarding of a public transport vehicle to the last alighting from a public transport vehicle. A PT TRIP consists of one or more RIDEs and the movements (usually walks) necessary to cover the corresponding CONNECTION LINKs.

Qualifier (Abstract) - ITN

A set of properties that specify the attributes of a node, link or partial link of a network, in particular the constraints that are relevant for consideration by routing engines, for example whether there is a dedicated bus lane.

A QUALIFIER is associated with node, link or partial link using a ROAD or PATH ROUTING INFORMATION. Multiple QUALIFIERs of the same or different types may be applied to compose complex conditions, for example that a route can be used in a particular direction (from an ENVIRONMENTAL QUALIFIER) by particular types of vehicles (from a VEHICLE QUALIFIER) at a particular time of day (from a DATE TIME QUALIFIER).

CNM adds LANE QUALIFIER and a PATH ADVISORY QUALIFIER.

Reference Object - DNF

General term for any GEOGRAPHIC OBJECT which is referenced by Business Objects or other GEOGRAPHIC OBJECTs.

Road Link – ITN-RN

A linear section designed for or the result of vehicular movement. This is the smallest unit of the ROAD NETWORK with a ROAD NODE at each end.

In CNM, a ROAD LINK is a type of LINK FEATURE.

Road Link Information – ITN-RN

Information that may influence the choice of route that applies to a single ROAD LINK in any direction of travel. Such information may apply to an entire ROAD LINK or relate to just a point along the ROAD LINK.

Road Network - CNM

A versioned set of ROAD LINKs and ROAD NODEs describing the road infrastructure of an area.

Road Node - ITN-RN

A FEATURE having topology with at least one ROAD LINK. A ROAD NODE has GEOMETRY and represents any of:

- The intersection or crossing of carriageways.
- The point where a road name or number changes.
- The point where a one way restriction cease to apply.
- The start end of a carriageway.

In CNM, a ROAD NODE is a type of NODE FEATURE.

Road Node Information - ITN-RN

Information that may influence the choice of route that applies to a portion of a single ROAD NODE in the network.

Road Partial Link Information – ITN-RN

Information that may influence the choice of route that applies to a portion of a single ROAD LINK in any direction of travel.

Road Partial Route Information – ITN-RN

Information that may influence the choice of route that applies to a portion of a ROAD LINK in a specified direction of travel.

Road Route Information – ITN-RN

Information that may influence the choice of route that applies to one ore more ROAD LINK features in a specified direction of travel.

Routing Information (Abstract) - ITN

Generic term for information pertaining to the routing use of a FEATURE LINK or FEATURE NODE, for example, for navigation by a particular mode, in a particular direction at a particular time.

There are different types of ROUTING INFORMATION element (for example, ROAD NODE INFORMATION, ROAD LINK INFORMATION, ROAD PARTIAL LINK INFORMATION, ROAD ROUTE INFORMATION, PATH LINK INFORMATION, etc) specifying different scopes of information. QUALIFIERs may be associated to specify the properties of ROUTING INFORMATION elements.

Service - CNM

SERVICE is a generic term for an activity at a specific FUNCTIONAL SITE.

SERVICEs can be associated with *Links* and *Nodes* using ROUTING INFORMATION elements.

Subjective Attribute - CNM

A property of a FEATURE that can be described with subjective criteria that is open to differences in interpretation, or that has an implication of liability that professional survey will wish to avoid. For example, whether a street is “safe”. Community surveys may still be able to offer useful assessments on an unwarranted basis.

Theme - ITN

A grouping of functionally related features ands other elements, for example the ITN ROAD NETWORK.

Toid - ITN

Unique persistent identifier of a FEATURE. Can be used to refer to a REFERENCE OBJECT within the DNF architecture.

Trip Pattern- Transmodel

The spatial pattern of a complete movement of a passenger (or another person, e.g. driver) from one PLACE of any sort to another. A trip may consist of one PT TRIP and the corresponding movements (usually walks) to cover the necessary ACCESS LINKs (Transmodel) and CONNECTION LINKs, or of one walk only.

Vehicle Journey- Transmodel

A transit between two points made by a vehicle. (In contrast to a TRIP PATTERN, which is the path taken by a person, which may involve one or more JOURNEYs.)

Vehicle Qualifier - ITN-RN

A set of properties that specify the constraints on use of a link or partial link by vehicles that are relevant for consideration by routing engines, for example whether HGVs can use a stretch of road. A Type of QUALIFIER.

4. USE CASES

The following high level Use Cases illustrate the use of CNM data in application functions and describe the specific usages that the model is intended to support. The use cases are intended to assist with verifying the scope and suitability of the model: the model should support all the purposes designated by the use cases - and does not need to support purposes not covered by the use cases.

4.1. *Use Cases:* Trip planning

The following Use Cases describe the use of Cycle data for the preparation of timetables and schedules.

JP#01 Trip planning using dynamic computation of routes

Cyclists wishing to find the best route between two points may use an interactive trip planner to find the best route. They will need to specify a start and end point as an address, place name, point of interest name, or point on a map. They may also wish to define different criteria about their preferences, such as shortest, simplest, quietest, etc. The trip planner will use the path network and other data to compute the most appropriate route that matches their criteria. It will present the results to the user on a map, or as a step by step list of directions, or both.

The computation of the optimal route may require a detailed representation of the junctions, for example the best manoeuvre to make to cross a complex junction. The trip planner will need to be able to determine the relationship of the network to other data such as addresses and places.

JP#02 Trip Planning using published maps of cycle routes

An alternative way for a Cyclist to interact with a trip planner is to look at a map of an area that shows the suitability of paths and roads for cyclists. The cyclist can plan their trip accordingly, choosing their start and end points. The map may be paper based or published electronically (e.g. as a PDF) or interactive (for example using a web browser with interactive maps). The information could include cycling infrastructure or recommended routes. The naming and labelling of such routes may need to correspond to physical signage along the route. Routes may be associated with particular attributes (e.g. safe, expert) and may be labelled with names and other identifiers. These routes shown will normally be fixed routes that have been statically defined by someone with expert knowledge of an area. Such routes may be given names.

JP#03 Cycle Trip Planning as part of a multimodal journey planner

Cyclists making longer journeys may wish to take their cycles with them on public transport, or wish to hire a cycle at their destination. In this case the cycle leg is part of a wider journey. The journey planner will include cycle legs in the journey, typically for the end legs of the journey. Such journeys will start and end at interchange points. Both carriage and hire of cycles may be subject to time restrictions.

JP#04 Facilities & Services for Cyclists

Cyclists may need to find specific facilities and services for cyclists such as repair shops or cycle parking. They may use maps or location based services to find the nearest facility. They may want to link to the website of the shop or other facility to find out further details.

4.2. *Use Cases:* Data Capture

The following Use Cases describe capture processes for the preparation and exchange of cycle model data.

Capt#01 Professional Survey of the Network, Points of Interest, etc

Organisations such as the Ordnance Survey and Cycle City Guides provide commercial services to professionally survey the environment, recording the features and their attributes in a form suitable for digitalisation. Such organisations establish a systematic process of classifying and processing data which they collect according to an attribute model, and then integrate it into databases as a managed process. A uniform set of categories is used for classification, that can be assessed objectively. All types of data may be collected in this way. Different organisations may specialise in different types of data – network, POIs, photos, etc.

These databases typically use systematic data reference systems that allow the data to be managed collated with references that are projected onto other data levels, for example attributes on top of a Road Network.

Survey capture processes will work with a trust model (see Gen#02) that can ascribe an appropriate level of authoritativeness and quality to data from different sources.

Capt#02 Collaborative capture of data as a Community Activity

The internet makes it possible for a distributed collaboration by members of the public to contribute to data about areas they know about. Contributors could use a web browser application (usually incorporating a map capability) or other software tools to add cycling data to a database. Different trust and IPR models may be used to record the ownership and level of verification for data from different sources (See Gen#02). Communities collecting data as a Common Good will normally want to ensure that their output is freely available to others. This does not preclude commercial use on an equitable basis.

Contributors may be invited to classify data according to a number of suggested criteria, including useful but more subjective measures that professional survey processes are not able to attribute. Capture applications may release captured data for immediate exchange, or may support a moderated process that allows data to be reviewed and checked before it is released, and to be assigned to an appropriate level of trust. Different levels of access privileges may be associated with different types of contributor. Different types of data – routes, attributes, addresses, photos, etc, may be contributed.

Collaboratively collected data may need to be managed at a fine grained level, for example individual routes. Ownership and rights to use data may need to be captured as part of the model.

Capt#03 Exchange of data

Organisations that have captured data need to exchange it with other organisations, for example trip and journey planners who wish to use the data. This requires both a data exchange format and a data reference system to ensure unique references to elements when serialising relationships. Different types of data may be exchanged, for example, routes, attributes, photos, etc. Data may be exchanged at different levels of granularity – the entire data set, such a region, or just changes to an existing data set. The same data may be updated over time as a replacement data set or a partial delta (see Gen#04).

Different users of the data will want to exchange different elements as part of different operational processes, though common formats can be used regardless of the user or the direction of exchange. For example, cycle route data might be captured by a community using an interactive map tool, that references ITN (or other) TOIDs. Some or part of this data may be exchange with an aggregator such as the Ordnance Survey or Open GIS data communities (see Capt#05). The aggregator may integrate the path links and attributes into their own data and distribute it as part of either their commercial or not-for-profit published data sets back to the capture community - and to other users such as trip planners (see Capt#06).

Thus the data will be aggregated and distributed as part of map data sets, in particular ITN RN & PN datasets. The Cycle Path layer data may also be exchanged by itself. The representation in particular for this last use needs to include metadata as to the source, IPR, etc.

Capt#04 Automated Cross-validation of data

Errors may arise in the data from a variety of causes. Some types of data can be detected by automated processes that apply common sense business rules (e.g. to avoid underwater or saltatory cycle routes). Some of these rules may be stated as constraints that must be implemented in data sets that meet quality requirements; these may be applied as occasional checks to look for discrepancies in data integration processes.

Capt#05 Integration of data by network and map data aggregators

Suppliers of mapping data must assemble many different types of data for features, geometry, address, etc, collating and validating it for integration in a uniform distribution format. To support cycle routes, an iterative process will be needed: the map supplier will provide a data set of the known road and pedestrian networks, including some cycle routes. Other applications may use editors and visualisation tools to update or augment this data set (as per use case Capt#02), returning their changes (as per format Capt#03) to the data aggregator for aggregation and distribution.

Capt#06 Integration of data by end-applications

Suppliers of trip planning systems (JP#01) must typically assemble topographical address, network and mapping data into a normalised format in order to transform it into the internal binary representation used by their trip planning engines. It must be possible to establish cross-references or projections between information layers and across data sets from different suppliers to make this possible, for example to relate the nodes of a cycle network with those of a road network and with access points to buildings. It must be straightforward to combine cycle data with road and pedestrian network data in particular.

Producers of maps (JP#02) will similarly use electronic publishing tools to project cycle routes onto their maps assigning appropriate colours, legends etc to the data elements.

4.3. General Use Cases

General use cases are common to many other cases include:

Gen#01 Distributed assignment of responsibility for Data Management

The data sets covered by CNM are potential quite large (all the cycle routes and paths in the UK and their routing data) and belong to many different stakeholders. The task of gathering, collating and aggregating the data must be distributed among many different organisations. Some degree of central coordination is needed to agree who is responsible for which type of data, to agree common interfaces, and to agree the partition of identifier namespaces, so that data coded to a common standard can be aggregated without clashes of the unique identifiers.

Gen#02 Levels of Trust & Objectivity

Data from different sources will be collected by both professionals and by amateurs with different levels of expertise. Professional organisations that collect data will typically only provide data that can be objectively verified and that does not expose them to liabilities or other challenges. Some types of subjective assessment may be open to differences in interpretation, so it is useful to know about the source of data. Within a community process, certain types of data may be liable to subversion to support partisan agendas – for example, to discourage cyclists from coming down a street by attributing it as bad for cycling regardless of the truth, or vice versa. For these reasons, it is important to include metadata that can support a trust model that can be used by applications to advise their use of data. A trust model will want to distinguish between the following source processes:

- Network & Geometry data from Professional Surveys.
- Network & Geometry data from Community Capture Processes.
- Objective attributes from Professional Surveys.
- Objective attributes from Community Capture Processes.
- Objective attributes from Community Capture Processes that have been verified by a community process.
- Subjective attributes from Community Capture Processes.

Confidence levels may also reflect the Survey Method – e.g. a ground survey versus a desktop study versus a computational derivation.

Gen#03 Temporal Change in Availability,

Systems must allow for the temporal change of path availability, through the opening or closing of roads or paths on particular days or at particular hours. Typically such changes are regular and known in advance and can be distributed as a validity condition along with other updates.

Gen#04 National Language Support

Systems that display or accept textual labels may need to allow for alternative place names in different National languages for textual names and terms of relationship. Typically systems will be coded in a primary language and aliases will be added for other languages, tagged with a language code.

Gen#05 Incremental Data Exchange

CNM data sets involve large qualities of data collected from many different systems. To coordinate the management of such data it is normal practice to use change attributes to allow the reconciliation of changes made in different places. This enables the incremental exchange of data.

Gen#06 System Evolution

In a distributed environment it is not practical for everyone to update their systems at once. Data exchange schemas should be designed to allow concurrent support for several levels of the format at once; including version numbers, etc that systems can reflect on to achieve this.

4.4. Other Use Cases

The data collected by may be used for other purposes as well:

Oth#01 Planning of Transport Networks

Transport planners and local government need data to assess whether transport networks are adequate and to determine where improvements would be worthwhile. A detailed path and cycle network is useful for planning access by cyclists and pedestrians.

Oth#02 Improving Road Safety

By mashing up cycle network data with road accident data to look for black spots with routes and other correlations, transport planners can identify places and measures that may improve cyclist and road safety.

4.5. Excluded Use Cases

The following Use Cases are explicitly excluded.

Ex#01 Signage and Asset

The model does not currently include data about signs for cyclists that may be provided on designated routes. These are considered street management assets.

Ex#02 Temporary Change in Availability

Roads and paths may be subject to temporary closure for road works or special events. Such changes are considered out of scope as they represent a different more transient availability of condition. They can be handled by existing road work notification systems, provided there is an appropriate reference to a feature.

Ex#03 Public Transport Network data

The CNM should not seek to capture or describe other elements of the transport network such as bus stops or bus routes as these are covered by other data sets and standards.

Ex#03 Real-Time data

The CNM does not seek to capture or describe real-time information affecting routing choices on the network such as traffic jams, current pollution levels, etc.

5. ASSUMPTIONS

This specification makes the following assumptions:

- ITN RN and ITN PN models are reused in the primary format for exchanging the base data, with additions to support cycle properties.
- A large proportion of data will be provided as part of the *Road Network*. This base network will be sourced from the Ordnance Survey as ITN.
- A *Path Network* is defined as a separate topological network for pedestrians (walkers and cyclists) which references and integrates with the *Road Network*. This is an important distinction and allows the two components of the overall network to be managed and updated independently.
- The geometry of the *Path Network* will adopt the ITN PN specification; PN data will be supplied by OS. Other data contributions may also be used.
- *Routing Information* elements are used to associate attributes that constrain the use of the network when routing with the Path and Road network. As in ITN, these may be specified to apply for all or part of a network link. In effect the Routing Information element specifies "where"; a separate *qualifier*, associated with the Routing Information, specifies "what"; for example, a one way restriction. This approach separates the respective concerns, allowing the same basic elements to be combined in different ways. The CNM adds a similar capability to have Routing Information for the Cycle Network Links to indicate cycle routing.
- *Cycle specific elements and attributes* define characteristics of this integrated network to form the desired routable cycle network. These are defined using DNF principles. Attributes are grouped under groups of distinct qualifiers. Where possible the CNM uses existing ITN qualifiers and attributes; further ones are added to support cycling, for example for lanes. Both objective and subjective attributes can be ascribed.
- The CNM follows the same design patterns and separation of concerns as used in the RN & PN, thus for example, Cycle attributes are added as qualifiers to *Routing Information* elements, rather than say directly to Cycle Links.
- The set of road and path links with attributes and other features can be used to compute sequences of links representing *Navigation Paths* between different points. The actual ordered sequences of the links of a navigation path can be regarded as a separate layer that may be derived dynamically or could be created statically by a Trip engine.
- The criteria for choosing a *Navigation Path* will depend on the user and can be described by a User Need model of preferences. It is useful to outline a model of Cyclist Needs to clarify the usefulness of the different attributes of the Network.
- It is not necessary to populate all features and attributes in a given data set; some areas may be sparse, others may be richly populated. It will be necessary to support different levels of data provision in different areas.
- An entity relation representation will be used to describe the model; this can be diagrammed with UML and implemented in XML, DDLs and other programming representations.

5.1. Example Processes

Table 5-1 shows, in approximate order of use, a possible sequence of processes that the various actors using CNM data would follow to capture and process cycle network data.

	Primary Actor	Process	Inputs	Outputs
1	**Mapping data provider**	**Distribute** existing map, road and path network data.	Area for which data is required by customers.	Road and path network data for area.
2	**National Data coordinator**	**Allocate unique prefix** for identifiers to be issued by community tool provider.	Registration by tool provider.	Reserved prefix.
3	**Community tool provider**	**Integrate** existing data into tool.	Road and path network data for area [1].	On line capture tool with map and network data from [1] integrated so that cycle routes may reference existing roads and paths, or also add new paths with their geometry. Data created is allocated a unique reference.
4	**Contributing Community member**	Uses online browser tool to **contribute** cycle routes. May also contribute path and road data.	Route points and cycle attributes.	Cycle network data in community data base, with contributor's terms of use.
5	**Community moderator (optional process)**	Uses online browser tool to **check** cycle network data and mark it for release.	Cycle network data in community data base.	Verified cycle network data in community data base
6	**Community data manager (or automated process)r**	**Export** data to other users.	Network i.e. group of Routes to be exported and conditions of use	Cycle network data with references to existing path and network elements.
7	**Trip planner provider**	**Integrate** cycle network data	Cycle network data with references to existing path and network elements.	Data integrated in trip p[lanner and on maps Journey
8	**Cyclist**	Plan trip, or look up route	Start and end destinations and preferences	Cycle trip plan.
9	**Mapping data provider**	**Integrate** cycle network data including augmenting existing road and path network data	Cycle network data with references to existing path and network elements.	Augmented and corrected map, road and path network data.

Table 5-1 Actors & Processes for using CNM data

6. EXAMPLES

Before describing the model, we illustrate the fundamental concepts of the CNM with some examples.

6.1. Cycle Links and Cycle Nodes

The basic representation provided by the CNM is illustrated in Figure 6-1, which shows a cycle network as a collection of nodes and links available to a trip planner.

Cycle Network Nodes and Links

- The cycle network consists of links and nodes, connected to have an origin and a destination end. There will usually be a single link to represent the possibility of cycle travel in both directions.
- The links and nodes have their own unique identifiers. As for all ITN FEATUREs, these identifiers are TOIDs that are systematically allocated so as to be unique and to allow reference to the network as DNF REFERENCE OBJECTs.
- Each link may have GEOMETRY, allowing it to be projected onto a map.

Cycle Network Attributes

- The Links and nodes may be given attributes describing their suitability for cycling, in particular ROUTING INFORMATION (See section 6.10 below). These include the same attributes used by the ITN RN model for Road Routing, and the ITN PN model for Path Routing, so it is possible to populate a cycle network from the road network data set and apply uniform routing semantics. It is also possible to populate the model to different degrees of detail – i.e. not every Node or Link needs to be given all possible attributes.

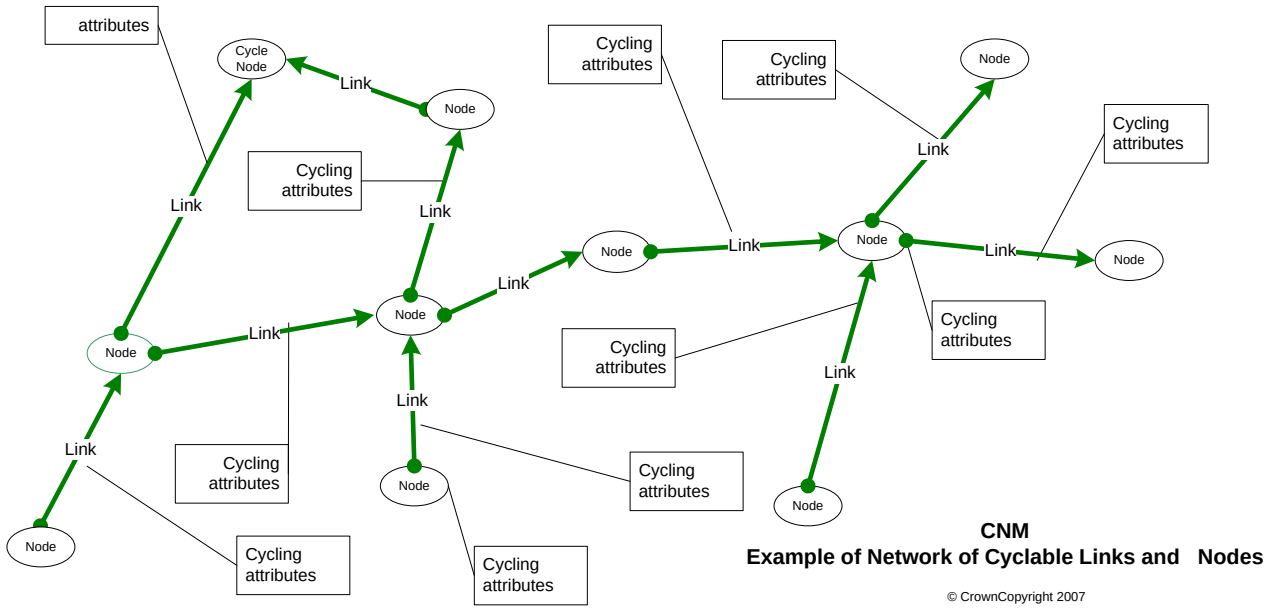

Figure 6-1 Example of cycle links and cycle nodes

6.2. Road Links and Path Links

In the CNM, the cyclable links and nodes shown above in Figure 6-1, are road and path elements of other underlying transport network models such as RN & PN, which provide GEOMETRY (and so are projectable onto a map). The cycle network can therefore be compiled from independent data sets of path links (*orange*) and road link data (*black*) sets which may be integrated together.

The CNM assumes the following essential reference model (See Figure 6-2) is provided by the RN and PN or other GDF compatible data source:

- The ROAD NETWORK consists of ROAD LINKs & ROAD NODEs and describes all roads and track accessible by motor vehicles.
- The PATH NETWORK consists of PATH LINKs and PATH NODEs and describes paths that are distinct from the road network, but which can be joined up at the nodes to create a single network.
- Each ROAD and PATH LINK may have GEOMETRY and can reference underlying cartography elements such as TOPOGRAPHICAL AREAs.
- ITN specifies means of connecting elements of different Networks using CONNECTING LINKS – see later below.

Accompanying the ITN network models are rules for populating them from the real world, for example, to specify to surveyors where nodes should be located, and when to use a single link or multiple links to span a section.

- The ROAD NETWORK covers all roads that publicly accessible by four-wheel motor vehicles (thus it may include roads with restrictions on access by type of vehicle, time of use, etc.
- It is assumed that most roads other than motorways can also be used as cycle paths, and the PATH NETWORK does not normally include links that duplicate the ROAD NETWORK.
- However in contrast to the PN, the CNM allows the use of additional PATH LINKs to describe segregated paths – *and in some cases unsegregated paths* - in particular, to be able to provide a detailed routing though complex junctions where the cyclist may use pavements and footpaths.

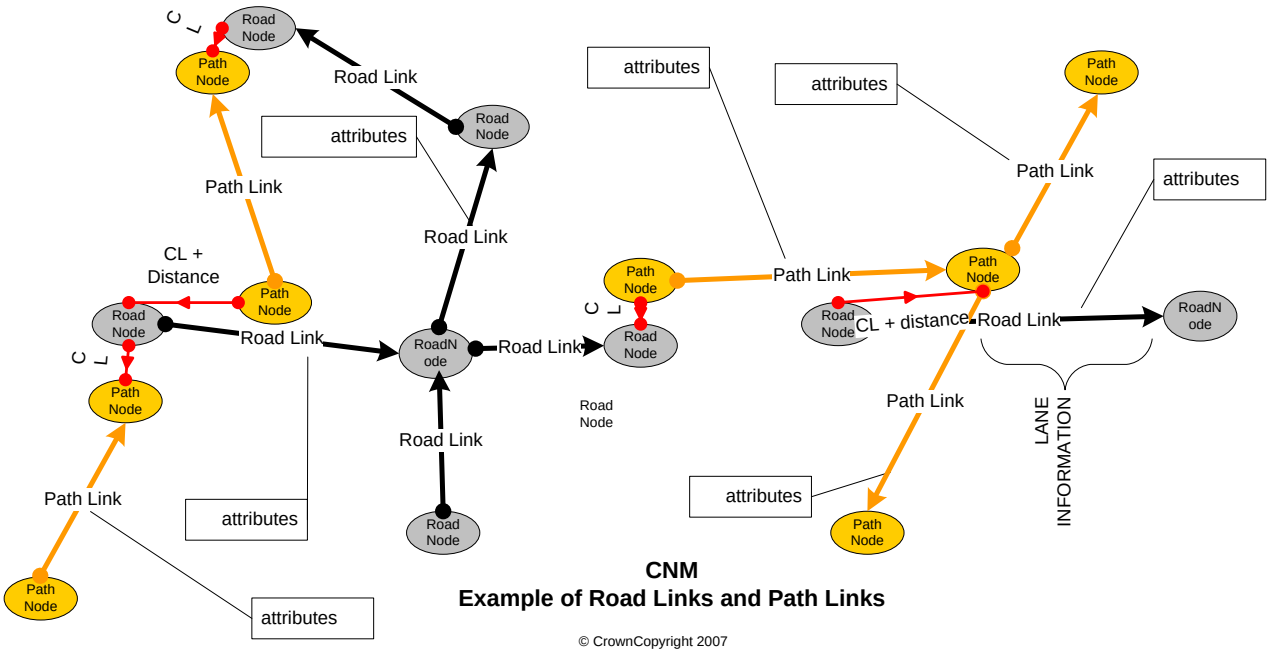

Figure 6-2 Example of PATH LINKs and ROAD LINKs

ROUTING INFORMATION may be derived from that of the corresponding RN or PN REFERENCE OBJECT element, or be specified additionally for Cycle specific values. In some cases, Cycle routing attribute values may be different from the vehicle road routing attributes; where present, Cycle attributes are assumed to have precedence for the CNM (These can be distinguished by their *Cycle Network* Theme).

6.3. Connecting Links

The path and road networks are separate: the points at which they connect are indicated with CONNECTING LINKS. These are illustrated as small red arrows in the figures of this section.

At each end of a CONNECTING LINK there is a CONNECTING NODE. A CONNECTING NODE references a ROAD NODE or PATH NODE. If a PATH LINK joins a ROAD LINK along its length the CONNECTING NODE connects to one of the ROAD LINK's nodes with an offset along the ROAD LINK to indicate the location the CONNECTING LINK joins the ROAD LINK. This is illustrated in Figure 6-2, as a "CL + Distance" CONNECTING LINK.

6.4. Offset Geometry

The CNM allows an additional subtype of PATH LINK, an OFFSET PATH LINK (and a corresponding OFFSET PATH NODE) with a GEOMETRY OFFSET and a REFERENCE OBJECT. The offset indicates the elements GEOMETRY can be derived and it should be rendered as following the REFERENCE OBJECT with a fixed displacement given by the offset. This is intended to provide an efficient way of describing the Geometry of cycleways that use the pavement beside a road.

6.5. Altitude & Contour optimisation

Some trip planners can provide contour optimised routing for cyclists to minimize the vertical height traversed. This requires the association of a vertical coordinate with individual nodes, and a profile along links which can be used to determine the relative rise and fall of the link. The CNM model indicates where this data can be included in the model. Profile data may be sourced from additional data sets.

6.6. Creating Cycle Network Data

Populating a CNM data set from RN or PN is thus a relatively straightforward matter of adorning PATH and ROAD NETWORK elements with Cycle attributes, and of adding some additional PATH LINKS where necessary to describe paths that are not normally distinguished by the PN.
A contributor exchanging cycle network data may thus choose to supply variously:

1. **Only the additional Attributes relating to Cycle Routing and Cycle facilities:** Just the cycle specific feature, with references to identifiers of existing ROAD LINKs and PATH LINKs (and ROAD NODEs and PATH NODEs) where relevant. Paths and roads that may be cycled on but are sufficiently described by the RN or PN network would be omitted. The road and path data could come from other suppliers (e.g. ITN RN & PN), as long as it used common TOIDs to identify elements. It would be assumed that where not specified, the routing attributes can be defaulted.
2. **The complete Cyclable Network:** The Cycle features and attributes, along with some or all of the paths (and even roads) also surveyed by the contributor. The Path and Road elements might provide map GEOMETRY provided by the OS or other community process. This provides a full description of the network.

6.7. Ferry Links

The ITN RN includes ferry links to indicate the possibility of moving between two points connected by water. The CNM schema includes the ITN ferry elements, which can be given the same CNM attributes as other links, but they are not shown in most of the UML diagrams in this document.

6.8. Navigation Paths on the ITN

Figure 6-3 shows an integration of the RN & PN networks to compute a NAVIGATION PATH (dotted red line); an ordered sequence of Cyclable links and nodes, that defines a trip plan for a cyclist.

This NAVIGATION PATH will normally be computed by a Trip Planner from a search of the network links available to it (both road, path) together with the cycle attributes, and so does not itself need to be exchanged as part of the CNM. The manually selection of route elements as belonging to a named cycle route by a data contributor may also in effect serve to identify specific NAVIGATION PATHs without recourse to a Trip planner.

Unlike a route, a NAVIGATION PATH is ordered, continuous and has a single start and end point. Advisory attributes, for example, the instruction to be observed to follow each step (e.g. left, uphill, etc) can be annotated.

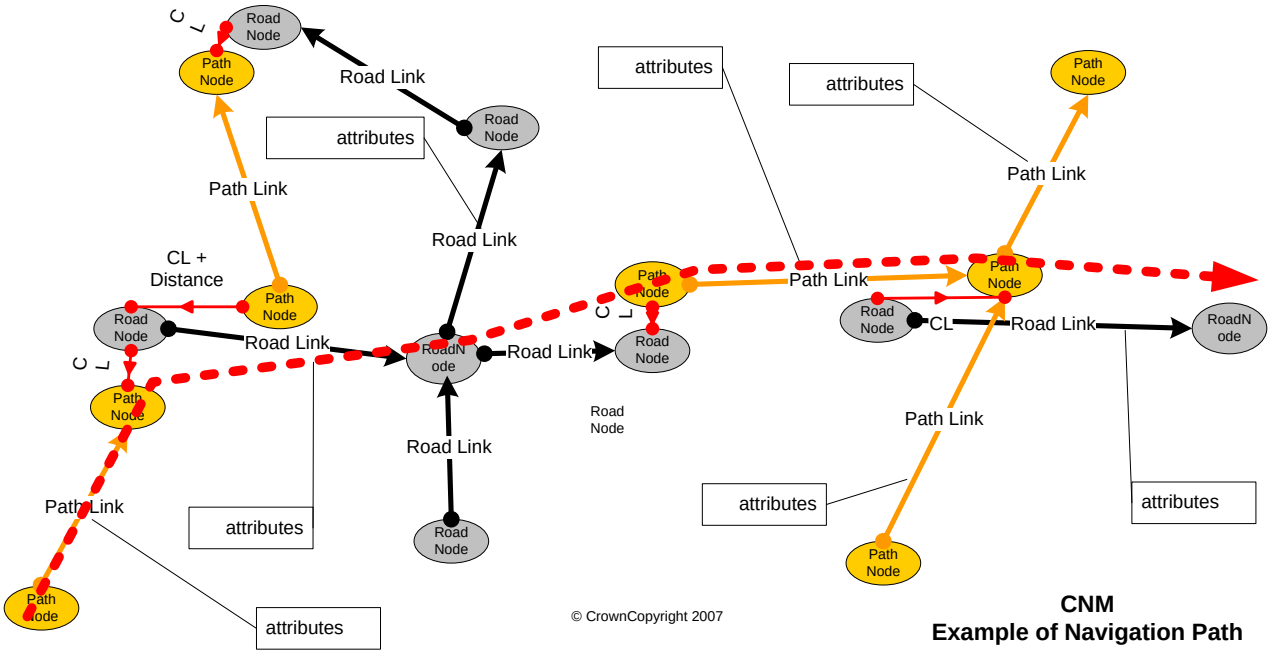

Figure 6-3 Navigation Path Example

6.9. Cycle Routes

Cycle network elements can be labelled as belonging to a named Cycle Route. In CNM, this is represented by an AGGREGATED WAY, a named set of links and nodes that can be used to describe a route and that can be given one or more labels.

- ROAD LINKs, PATH LINKs, ROAD NODEs, PATH NODEs and other NETWORK MEMBERs can be assigned to an AGGREGATED WAY.
- The AGGREGATED WAY does not imply a single NAVIGATION PATH: it may have branches and may even have gaps between sections.
- A cyclable link or other NETWORK MEMBER may belong to more than one AGGREGATED WAY.
- The label of an AGGREGATED WAY is specified by a separate CYCLE INFORMATION element. This allows the same AGGREGATED way to have multiple names, for example *National Route 22, Local Route A1.*

This is shown in Figure 6-4 which shows an aggregated way labelled as ”CN26”.

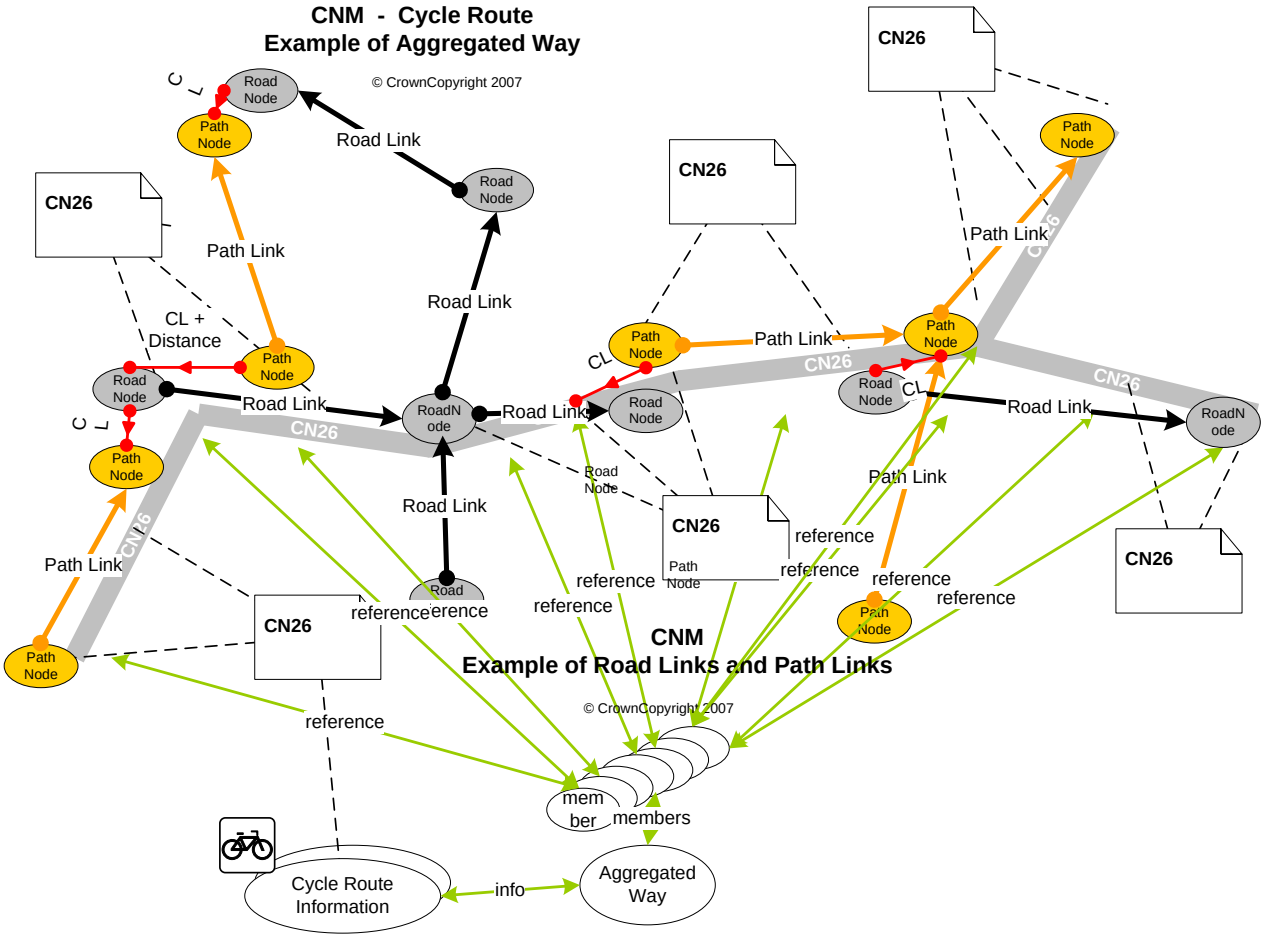

Figure 6-4 Example of Cycle Route as Aggregated Way

An AGGREGATED WAY will typically be created by manual selection using an interactive tool to annotate network elements as belonging to a named cycle route.

6.10. Routing Information

To specify the attributes that affect routing over the networks by the routing engines of trip planners, routing related attributes are specified, such as the direction of use; the types of motor vehicles allowed on the link, and whether a turn can be made at a junction. These attributes, specified as groups of QUALIFIERs, can be associated as applying with all or part of a network link (as LINK INFORMATION or PARTIAL LINK INFORMATION), and in one or both directions (as ROUTE INFORMATION or PARTIAL ROUTE INFORMATION). See Figure 6-5.
In effect: ROUTING INFORMATION elements specify *where* routing information applies. QUALIFIERs specify *what* routing information applies.

Routing - *Where*

- In the CNM, ROUTE INFORMATION can be specified for both ROAD LINKs and PATH LINKs. It includes the same attributes that may be specified for ROAD LINKs in the ITN RN (see [ITN1] and Annex A).
- CNM supports the same LINK. PARTIAL LINK, ROUTE and PARTIAL ROUTE INFORMATION elements that are supported in the ITN RN for roads. In the CNM, these may also be specified for Paths. This allows routing constraints that apply along part of a cycle way or at a particular point on a cycle way to be described.
- CNM also has a LANE INFORMATION element which can be used to specify qualify attributes that apply to one, some or all lanes of a Road (or even a cycle path that has lanes).
- There may be more than one ROUTING INFORMATION associated with a LINK or NODE, covering different points or sections of the LINK.
- A single ROUTING INFORMATION may be associated with multiple LINKs or NODEs, indicating the attributes apply to all the elements.

Qualifiers - *What and When*

- Attributes are grouped into QUALIFIERs, including the three ITN ones, governing the temporal scope (DATE TIME QUALIFIER), the fixed environment (ENVIRONMENTAL QUALIFIER), or the means of transport (VEHICLE QUALIFIER).
- The CNM in addition allows two further QUALIFIERs:
    - The LANE QUALIFIER allows constraints to be specified that may apply to individual lanes, for example the nature of the surface. It is also possible to use a LANE QUALIFIER to specify that properties apply to all LANEs.
    - The PATH ADVISORY QUALIFIER allows subjective attributes to be associated with a PATH LINK, such as whether it is “Easy” or “Recommended”.
- More than one QUALIFIER can be combined on a ROUTING INFORMATION additively, for example, particular environmental constraints might apply at a particular date and time.

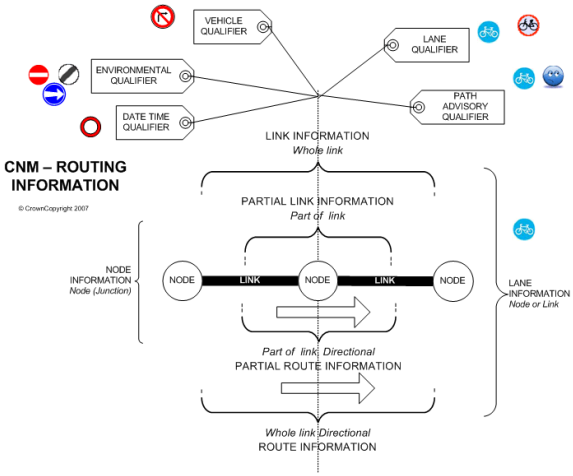

Figure 6-5 Routing Information and Qualifiers

6.11. Manoeuvres at a Junction

For cyclists, some transits through a road junction may be easier than others. Furthermore, options may be open to cyclists that are not open to drivers of motor vehicles, for example to dismount and walk over a pedestrian crossing.

In the CNM, the merits of a particular transit can be represented on ROUTING INFORMATION.

- A ROUTING INFORMATION element can be used to connect two or more links traversed by the manoeuvre, including the start and end.
- A LANE INFORMATION can be used to further indicate a lane for each ROUTING INFORMATION and LINK – see next section.
- The relative ease of the MANOEUVRE may be indicated on the CYCLING MANOEUVRABILITY by a RATING (*easy, poor, prohibited*, etc.).
- Advice on the use of the MANOEUVRE may also be specified with a CYCLING INSTRUCTION – e.g. *Dismount Onto Pavement*, *On Carriageway*, etc.

To indicate the use of pavements or crossings as cycle ways for a manoeuvre, in some cases further explicit PATH LINKs may be created to describe paths along the pavement. Note that this is in contrast to the ITN rules, which require surveyors **not** to create separate PATH LINKs for paths that are not segregated from the road.
Figure 6-6 illustrates the use of ROUTING INFORMATION to describe various turns at a crossing.

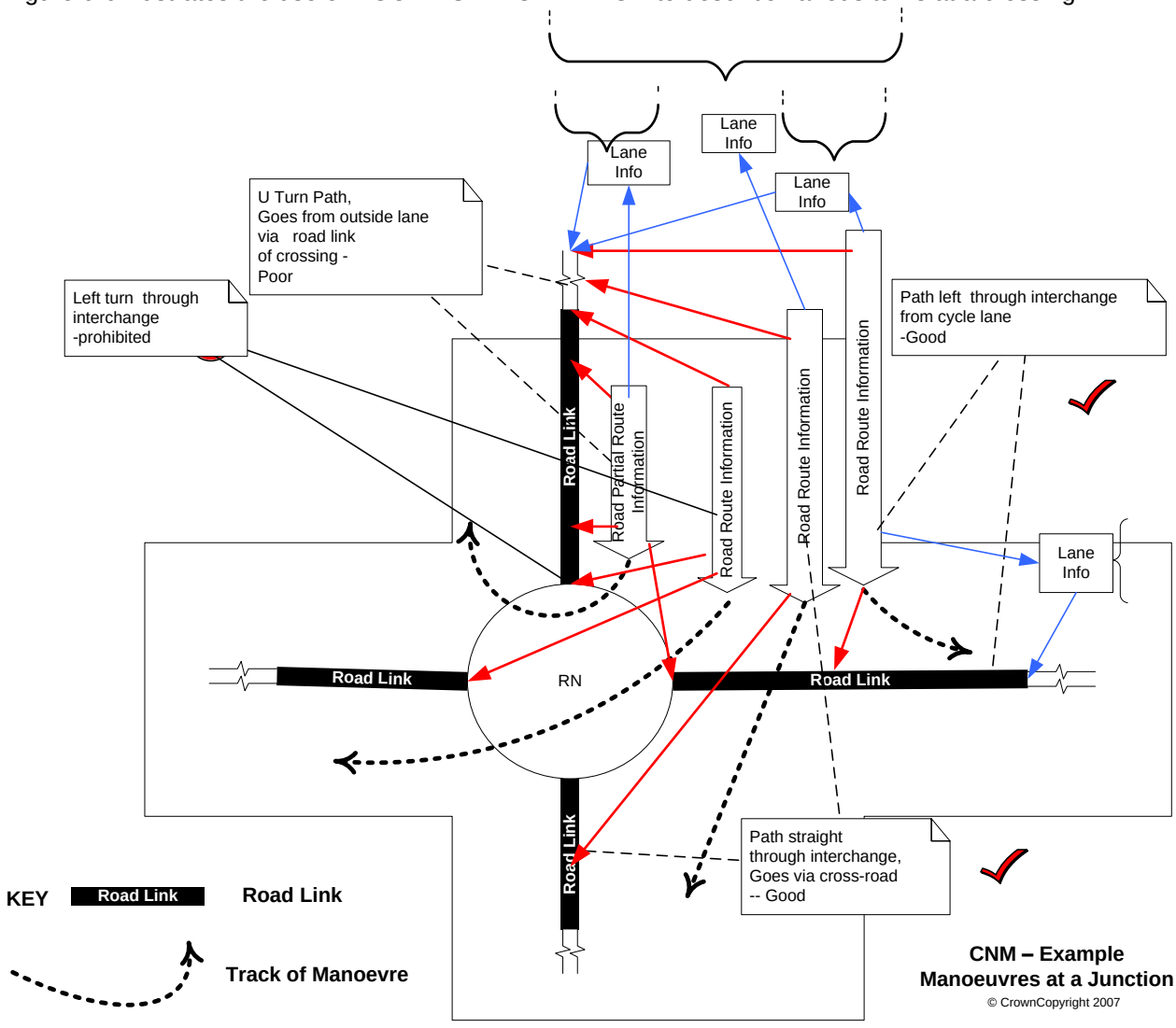

Figure 6-6 Example of Manoeuvres at a Junction

If no explicit MANOEUVRABILITYs are stated, then Trip Planners will typically use a default weighting, depending on the turn and type of road. For example:

- Left turn – normal.
- Straight ahead – Normal.
- Right turn across traffic – Expert.
- Right turn from one way road – Normal.

6.12. Use of Lanes

Lanes are used in the CNM to describe properties of a road link or section that apply to only part of the carriageway or pathway.

To indicate the location of the lane, a LANE INFORMATION element is used and can be associated with all or part of a link by associating the LANE INFORMATION with a ROUTING INFORMATION, for example a, a ROAD PARTIAL LINK INFORMATION, a ROAD ROUTE INFORMATION, etc. In some cases PATH LINK INFORMATION may also have lanes – for example a dedicated cycle track with multiple cycle lanes.

To indicate the lane, LANE INFORMATION elements are be numbered from the inside lane out, in the direction of the link.

The actual properties of a lane are specified using LANE QUALIFIERs, which can describe aspects such a CYCLING PROVISION (e.g. cycle lane, bus lane, etc), CYCLE USE (shared, cycle only, etc), SURFACE (e.g. cobbles, tarmac). See section 0.

This lane construct is used to model many real world features including

- A dedicated cycle lane
- A shared use cycle lane with traffic calming
- A lane with a different surface to the rest of the road carriageway
- A cycle barrier on path

Note LANE QUALIFIERs can also be associated with ROUTING INFORMATION without the use of a LANE INFORMATION to indicate that the properties apply to all lanes for the section described by the ROUTING INFORMATION.

6.13. Functional Sites & Access Links (ITN)

The ITN network can also provide information about geographical features and about places of interest on the map that cyclists may want to travel to. Figure 6-7 shows a more detailed example of nodes and links making up a combined RN & PN network, with examples of roads, roundabouts, bridges, paths, etc, from the different Road (*black lines*) and Path (*orange and green lines*) networks, joined seamlessly together. The network also connects to a FUNCTIONAL SITE which has designated entrances to which to connect the transport networks. (For Public Transport Stops & Stations, this could also be related to a NaPTAN or IFOPT node).

- Different types of PATH & ROAD ROUTING INFORMATION (RRI) can be associated with links to indicate their suitability for routing (indicated by tags and icons).
- CONNECTING LINKs (*small red arrows*) can be used to connect nodes of different networks. Each end of a CONNECTING LINK is a CONNECTING NODE, which may in turn reference a ROAD NODE or PATH NODE.
- FUNCTIONAL SITEs, together with ACCESS NODEs, are used to represent buildings, parks, etc, and their entrances. A FUNCTIONAL SITE has designated entry points, indicated by its ACCESS NODEs, to which it is connected by ITN ACCESS LINKs (Note that this is a different usage of the term ACCESS LINK from that made in Transmodel). ACCESS NODEs can also be joined to the Road or Path Network using CONNECTING LINKs/NODEs.

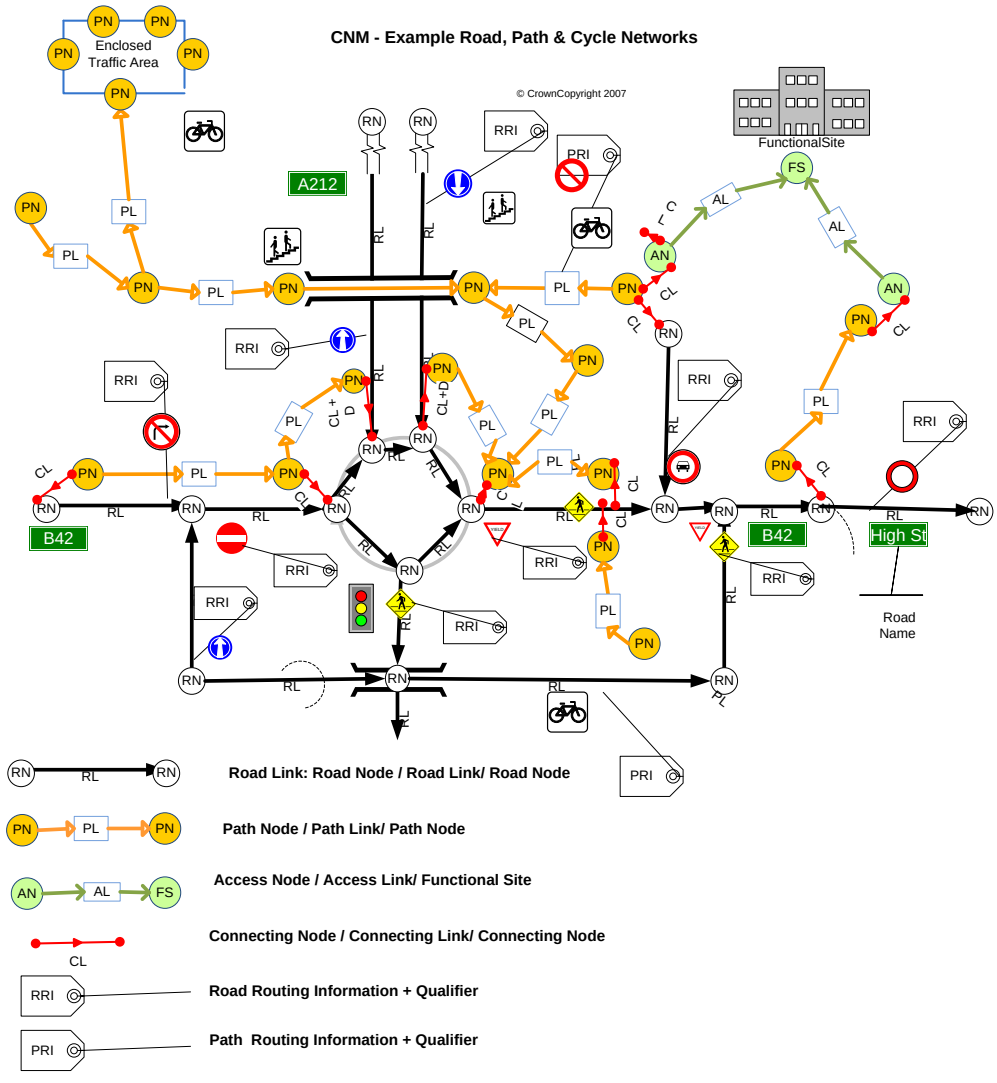

Figure 6-7 ITN Network Example

Some further detail is given in Annex A. See [ITN1] for definitive details on the rules for describing roads as ROAD LINKs and ROAD NODEs. See [PN1] for the definitive rules on describing paths as PATH LINKs and PATH NODEs and for connecting networks.

7. DATA MODEL

7.1. Introduction to the CNM Data Model

This section presents the CNM entities and relationships, including those needed to describe cycle routing. The chapter is concerned primarily with the structure of the model and its relationship to other layers. Descriptions of individual cycle data attributes are given separately in Chapter 9.

The standard UML notation for class structure diagrams is used to present structures. In addition, as an aid to readers, colour is used to group functionally related elements, for example those from PN, RN or the CNM itself.

The CNM model is built upon the ITN RN & PN models and so has the following layers:

1. Cycle Network Routing Information, Qualifiers & Attributes.
2. Path Network with Routing Information, Qualifiers, & Attributes.
3. Road Network with Routing Information, Qualifiers & Attributes.

Thus an instance of the CNM will comprise Cycle network elements that reference RN & PN links and nodes, along with appropriate routing information.

To support Cycle Trip Planning, an additional model is required to specify the inputs and outputs of cycle trip planning requests. These are not part of the CNM data model, but it is useful to indicate how the data from the CNM can be used in trip planning to compute Cyclability (See also use cases JP#01-#06). Use of trip related elements is discussed very briefly in a separate chapter on Navigation Paths (See Section 8).

Note that the UML representation is a schematic representation intended to convey the structure of the model. It is not an exact description of the XML schema, which though similar, has a number of small differences.

Relationship to ITN RN & PN models

To understand the CNM fully, some understanding of the base ITN RN & PN models is necessary – a brief summary of the RN & PN, stating the models using the same conventions as used for the CNM in this document, is given in Annex A. The CNM can be understood as a further generalisation of the ITN RN & PN model to describe cycle paths and cycle routing, and to allow collaborative collection of data by the community (rather than just the OS).

We present the CNM in the following steps:

1. Introduction to CNM core elements.
2. Overview of full CNM.
3. Detailed attributes of CNM core elements.
4. Detailed attributes of CNM COMMUNITY RIGHTS elements and other common properties.
5. CNM Routing attributes.
6. CNM Qualifiers.

The Essential CNM Model

Figure 7-1 summarises the core elements of the CNM model, including the relationship to ROAD LINKs and PATH LINKs.

In this and subsequent diagrams, a cycle icon indicates those items which are specific to the CNM model. Other elements can be considered to be generic to the RN & PN models (See Annex A).

Cycle Network Elements:

- A Cycle Network is made up of FEATURE LINKs and FEATURE NODEs links may be ROAD LINKs, PATH LINKs, or OFFSET PATH LINKs; nodes may be ROAD NODEs, PATH NODEs, or OFFSET PATH NODEs.
- NODEs mark the start and end of a LINK. Each LINK connects to two NODEs via a DIRECTED NODE, negative at the origin end, positive at the destination end.
- ROAD LINKS connect ROAD NODEs, PATH LINKs connect PATH NODEs.
- An additional type of link, a CONNECTING LINK, is used to connect ROAD and PATH nodes either exactly at a node or to a point along a link relative to one of its end nodes.

Geometry and associations with Road and Path Networks:

- As types of FEATURE NODE and FEATURE LINK respectively, ROAD NODEs, PATH NODEs, ROAD LINKs and PATH LINKs have their own GEOMETRY. An OFFSET LINK references a ROAD or PATH LINK for its GEOMETRY and default ROUTING INFORMATION.
- A CONNECTING LINK does not usually have its own GEOMETRY.
- NODEs may have an altitude; LINKs may have a PROFILE of multiple altitudes which can be used to determine the relative rise and fall of the link in order to do contour optimised routing.

Routing Information

- FEATURE ROUTING INFORMATION elements allow the association of routing information for cycling with one ore more FEATURE LINKs and NODEs. The actual routing attributes are specified as QUALIFIERs that apply to a specific FEATURE ROUTING INFORMATION.

Generic Properties:

- ROAD NODE, PATH NODE, etc may be considered concrete subtypes of a generic abstract type of FEATURE NODE that describes common properties.
- Similarly ROAD LINK and PATH LINK are types of FEATURE LINK, which is in turn a type of FEATURE.

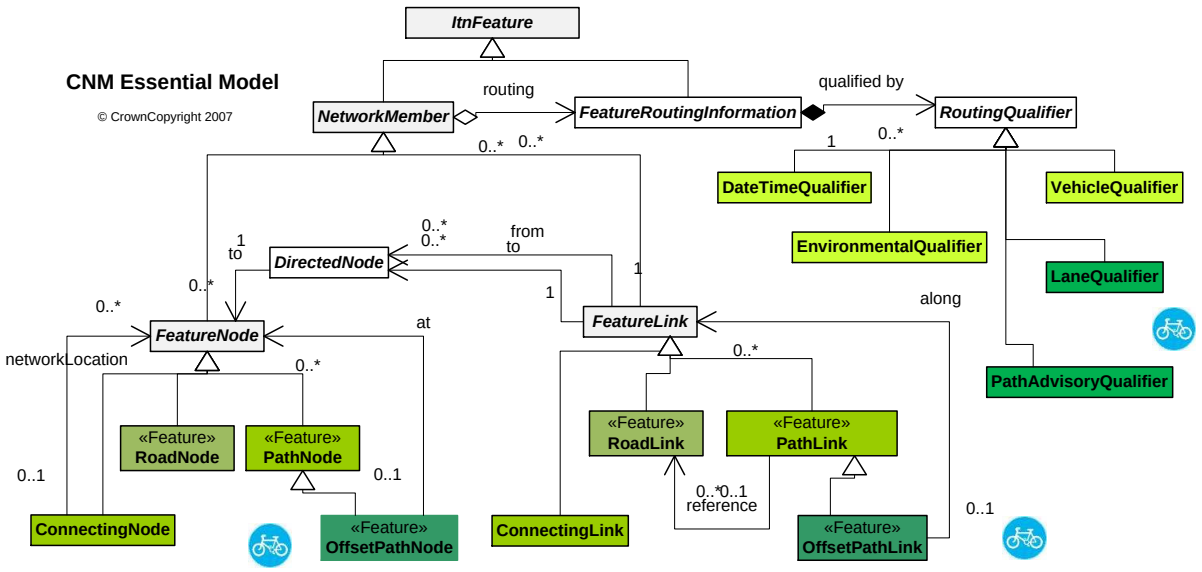

Figure 7-1 UML Diagram of CNM Essential Model

Overview of Full CNM Model

Figure 7-2 gives an overview of the full CNM.

Generic properties of CNM Features:

- COMMUNITY RIGHTs are common properties for all FEATUREs, along with CONTRIBUTOR, CONTRIBUTOR ORGANISATION and CONTRIBUTION elements, as described further in the next section.
- FEATURE INFORMATION allows urls to images and other resources to be associated with any feature.
- FEATURE ALIAS allows identity of derived data to be maintained on round trip data exchange.

RN & PN elements used in the model would also be given these properties so that Paths and Roads provided by the Community Process can be handled on separate IPR terms from OS data if desired.

Routing Features:

- PATH ROUTING INFORMATION (PRI) elements allow the specification of routing information for cycling as path QUALIFIERs that apply to some or all of a PATH LINK and in a specific direction. These are
    - PATH LINK INFORMATION (already supported in PN): whole link, both directions.
    - PATH PARTIAL LINK INFORMATION; part of link, both directions.
    - PATH ROUTE INFORMATION; whole link, one direction.
    - PATH PARTIAL ROUTE INFORMATION; part of link, one direction.
    - LANE INFORMATION: specified which (or all) lanes the information applies.
    - PATH NODE INFORMATION; whole node.

- QUALIFIERs can be specified for PATH ROUTING INFORMATIONs, allowing routing related features on all or part of PATH LINKs.
    - DATE TIME QUALIFIER; The temporal scope of information
    - VEHICLE QUALIFIER. Vehicle restrictions.
    - ENVIRONMENTAL QUALIFIER; Restrictions from the environment, including some cycle related properties such as SURFACE.
    - LANE QUALIFIER; Restrictions that may apply to one or many lanes.
    - PATH ADVISORY QUALIFIER; Subjective Path attributes, including Cycling attributes may be specified. These can include subjective ratings.

Additional generic Model Features:

- An AGGREGATED WAY element allows cycle routes, to be labelled with a single name; they are analogous to RN ROAD elements.
    - Membership of an AGGREGATED WAY is indicated by a ROUTE MEMBER element. A NETWORK MEMBER may belong to more than one AGGREGATED WAY
    - The description of a cycle route is provided by a CYCLE INFORMATION ELEMENT associated with an AGGREGATED WAY.
- An ENCLOSED TRAFFIC AREA feature is added to the ROAD NETWORK to describe squares and open spaces that may be traversed in a vehicle or cycle.
- A PLACE REFERENCE allows one or more external elements such as NaPTAN STOP POINTs, Points of Interest, etc to be explicitly associated with a site.

Additional CNM Features:

- A PATH NETWORK element is provided to allow the explicit grouping of elements for exchange between systems. When exchanging data, common values such as COMMUNITY RIGHTs can be specified for the PATH NETWORK, which are then assumed to apply to all members unless overridden on a particular element.
- A *Cycle Network* THEME is introduced as metadata to mark cycle related elements.

- CYCLE INFORMATION element allows cycle route names and classifications to be given to an AGGREGATED WAY.
- CYCLE SERVICEs (CYCLE SHOPs, CYCLE PARKING etc) can be associated with FUNCTIONAL SITEs.

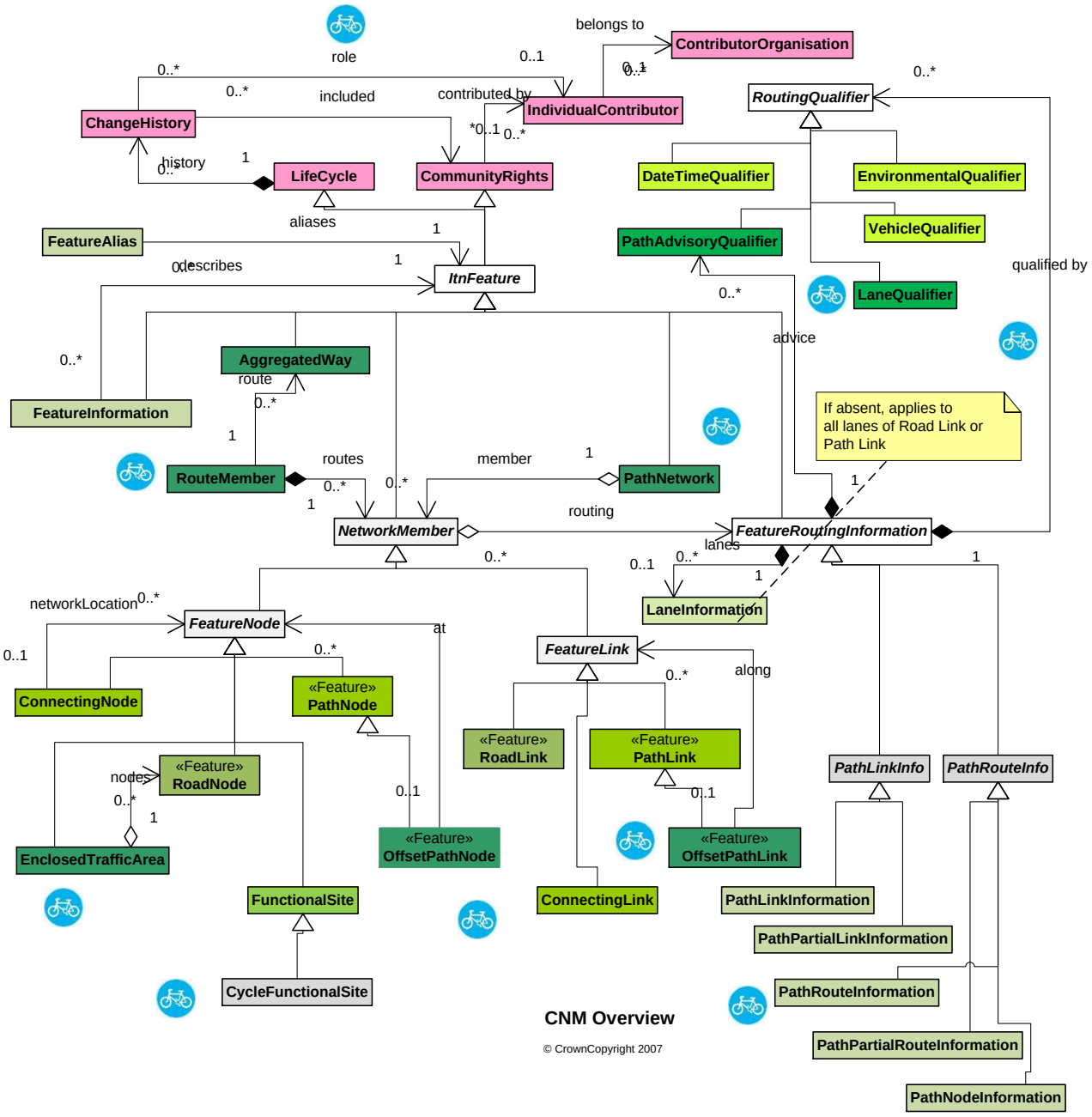

Figure 7-2 UML Diagram of Overview of full CNM

Attributes of Core CNM Elements

Figure 7-3 shows the detailed attributes of the core CNM elements introduced in Figure 7-1. See Chapter 9 for descriptions of the data types and enumerations used, and [ITN1], [ITN2], [PN1] and ANNEX A for details of attributes used in the existing ITN RN & PN.

- The type and nature of a ROAD LINK are specified using the RN attributes (e.g. *motorway*, *A Road,* etc).
- The type and make of a PATH LINK are specified using the RN attributes (e.g. *footpath*).
- Common ITN GEOMETRY is used for all FEATUREs, including POINTs and POLYLINEs.
- OFFSET PATH NODE and an OFFSET LINKs may also have a GEOMETRY OFFSET.
- To support contour optimised routing, an altitude may be specified on a FEATURE NODE, and a height profile on a FEATURE LINK.

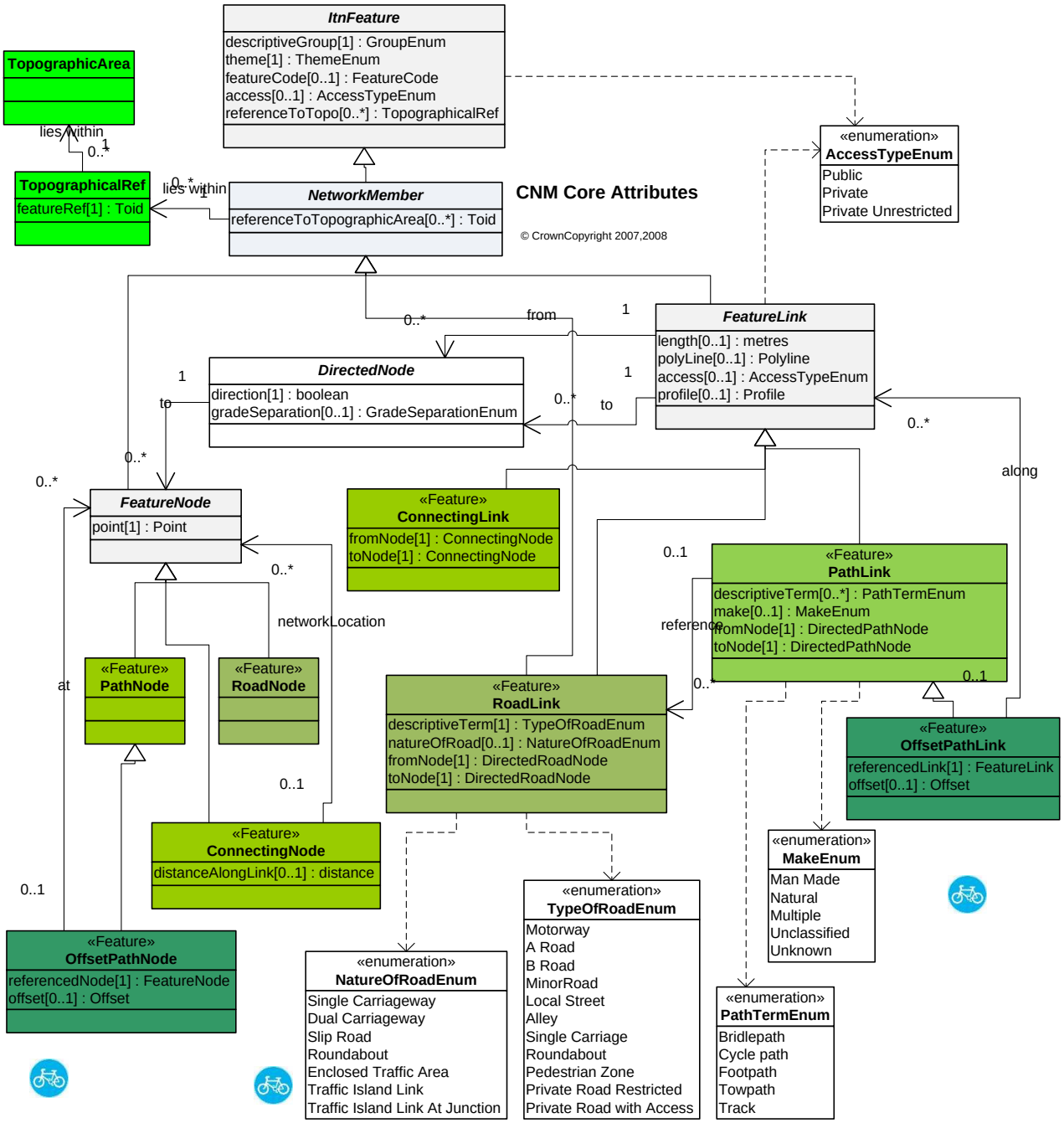

Figure 7-3 UML Diagram showing detailed Attributes of CNM core Elements.

Attributes of CNM Community Rights and Generic Elements

Figure 7-4 elaborates Figure 7-2 above to show the common detailed attributes of the FEATUREs of the CNM, in particular those that are concerned with change management in a distributed collaborative environment - such as are required for the community exchange of cycle data.

The community attributes could be also applied to manage standard RN & PN elements (e.g. Road and Path Links) contributed by the community. Existing RN & PN data sets could be populated with appropriate values reflecting OS ownership and IPR conditions.

Life Cycle Management Elements:

- All features have LIFECYCLE properties recording their status and a CHANGE HISTORY recording the time and nature of each update. The common version and change date properties are the same as for the ITN RN & PN models.

Community Right Elements:

- COMMUNITY RIGHTS specify the source and allowed use of the data, and apply to all FEATUREs, along with the common LIFE CYCLE elements.
- The CONTRIBUTOR indicates who contributed the data, and provides contact details.
    - Different CONTRIBUTIONs are possibly by different CONTRIBUTORs, specifying different CONTRIBUTOR ROLEs, for example, *supply, verification, aggregation, owner, etc.*
    - A direct association with the original source CONTRIBUTOR who originally created the data is always recorded, and is used as a default for all other possible roles if they are not explicitly populated. Thus it is assumed that the owner of the data is the source contributor unless stated otherwise.
    - Additional contribution roles as *verifier*, *aggregator* etc can be recorded by additional CONTRIBUTION instances. The date and time of these may be recorded by a CHANGE HISTORY element that references the CONTRIBUTION element.
- A CONTRIBUTOR ORGANISATION indicates the data management to which the contribution is made. A Contributor Organisation will have a CONTRIBUTOR who acts as the manager for it.

COMMUNITY RIGHTs may be specified on any element of the CNM, but a principle of *subsidiarity* will be assumed – rights specified on a parent element will apply to all its contained children. Thus for example those on a PATH NETWORK container will apply to all elements belong to the network unless overridden on an individual PATH LINK, PATH NODE or other element. Similarly the rights on a PATH LINK apply to its nodes, qualifiers, etc.

COMMUNITY RIGHTs can also optionally record:

- The SURVEY METHOD and VERIF|CATION STATUS of the data is also recorded, indicating the level of quality assurance.
- ALLOWED USE specifies the terms upon which the data is allowed to be used; for example: *Unrestricted use; Not for Profit Use; Use under an Open Source licence; Use under a commercial licence*.

Grouping Elements for the CNM:

The CNM includes elements to enable the explicit Grouping of data:

- PATH NETWORK allows groups of FEATUREs to be assembled and exchanged as a versioned set.
- A *Cycle Network* THEME is used to label CNM elements as a functional group (this is in effect a metadata grouping).

Additional Common Properties of all CNM Features:

Additional common properties are supported on data elements:

- FEATURE INFORMATION allows urls to images and other resources to be associated with any FEATURE. This allows photos for example to be added, or urls to the contributor's sites.
- FEATURE ALIAS allows the identity of derived data to be retained on round trip exchange between different systems. Thus if a data provider incorporates and allocates new identifiers to data elements originating from another contributor (as say the OS may well do), one can still record the original contributors identifiers, allowing the original contributor (and others) to reconcile returning data.

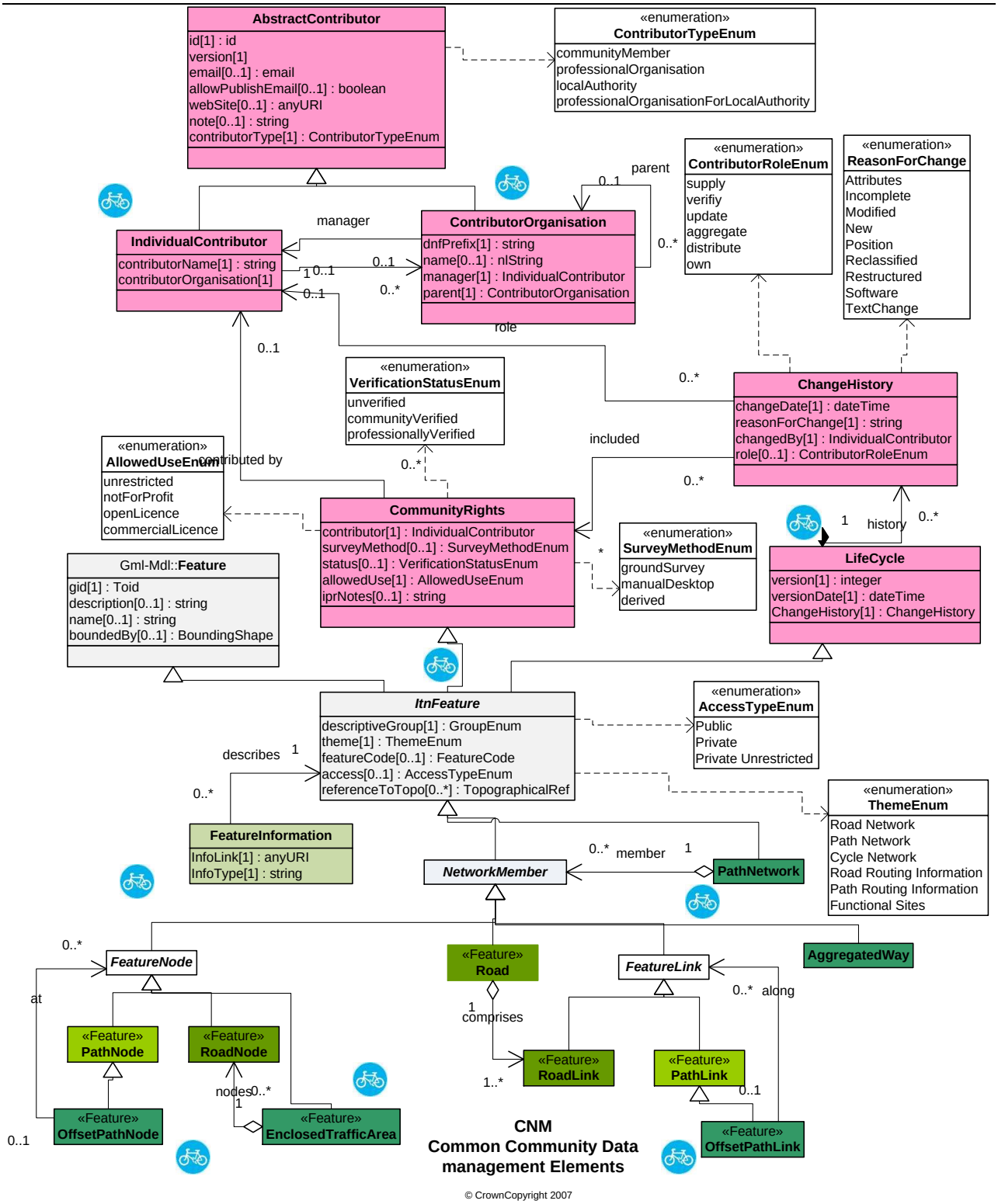

Figure 7-4 UML Diagram of CNM detailed Community and Generic Attributes

Allocation of Identifiers

In order to ensure DNF unique identifiers for CNM elements, each CONTRIBUTOR ORGANISATION must have its own prefix to use for allocating TOIDs. (It is not considered practical to do this at the level of individual users). This will be used to generate TOIDs for all CNM elements originated by any member of the CONTRIBUTOR ORGANISATION. This prefix will correspond to a DNF Organisation id - See [DNF3]. Each CONTRIBUTOR ORGANISATION must therefore register its prefix with the DNF register.

CNM Model Details

Figure 7-5 shows detailed attributes of the CNM that have not yet been (i) described as part of the CNM in section 0 or (ii) previously covered by the discussion of general CNM change management and community right attributes in Section 0 above.

Cycle Route Support:

- AGGREGATED WAY – a Named path
- CYCLE INFORMATION – Annotates an AGGREGATED WAY as a named Cycle Route, giving it a name and type.
- ROUTE MEMBER assigns a Path NETWORK MEMBER to a specific AGGREGATED WAY. A NETWORK MEMBER may belong to more than one AGGREGATED WAY, so there map be many ROUTE MEMBERs for a NETWORK MEMBER.

Data Grouping:

- PATH NETWORK – A grouping of elements as a named network.
    - Can be used to set common VERSION, COMMUNITY RIGHTS, etc. to apply to all model elements, reducing the amount of data exchanged.

Routing:

- PATH ROUTING INFORMATION elements are similar to those for ROAD ROUTING INFORMATION:
    - PATH LINK INFORMATION – Applies to whole link or links.
    - PATH PARTIAL LINK INFORMATION – Applies to part of link.
    - PATH ROUTE INFORMATION – Applies to whole link or links in a specified direction.
    - PATH PARTIAL ROUTE INFORMATION – Applies to part of link in a specified direction.
- The ITN PATH ROUTING INFORMATION includes a PATH INFOR TERM which describes the nature of the PATH LINK, e.g. *footbridge, pedestrian crossing, subway, etc.*
- LANE INFORMATION specifies which lane ROUTING INFORMATION applies. Lanes are numbered starting from the curb side in the positive direction of the link, with the hard shoulder as a special case. If no lane is indicate it is assumed that the lane properties apply to all lanes.

Routing Geometry:

- To describe the scope of a PARTIAL LINK or PARTIAL ROUTE, a SUBSECTION START POINT, and SUBSECTION END POINT, SUBSECTION START DISTANCE, and SUBSECTION END DISTANCE may be used.
- To describe a point location for PATH LINK INFORMATION or PATH ROUTE INFORMATION, a START POINT, and DISTANCE FROM START may be used.

Other Cycle data:

- CYCLE SERVICES - Facilities represented as a FUNCTIONAL SITE. These may be CYCLE PARKING, CYCLE HIRE, CYCLE SHOP, etc.
- PLACE REFERENCE – a cross reference to other identifiers of the place used by other data reference systems such as NaPTAN.

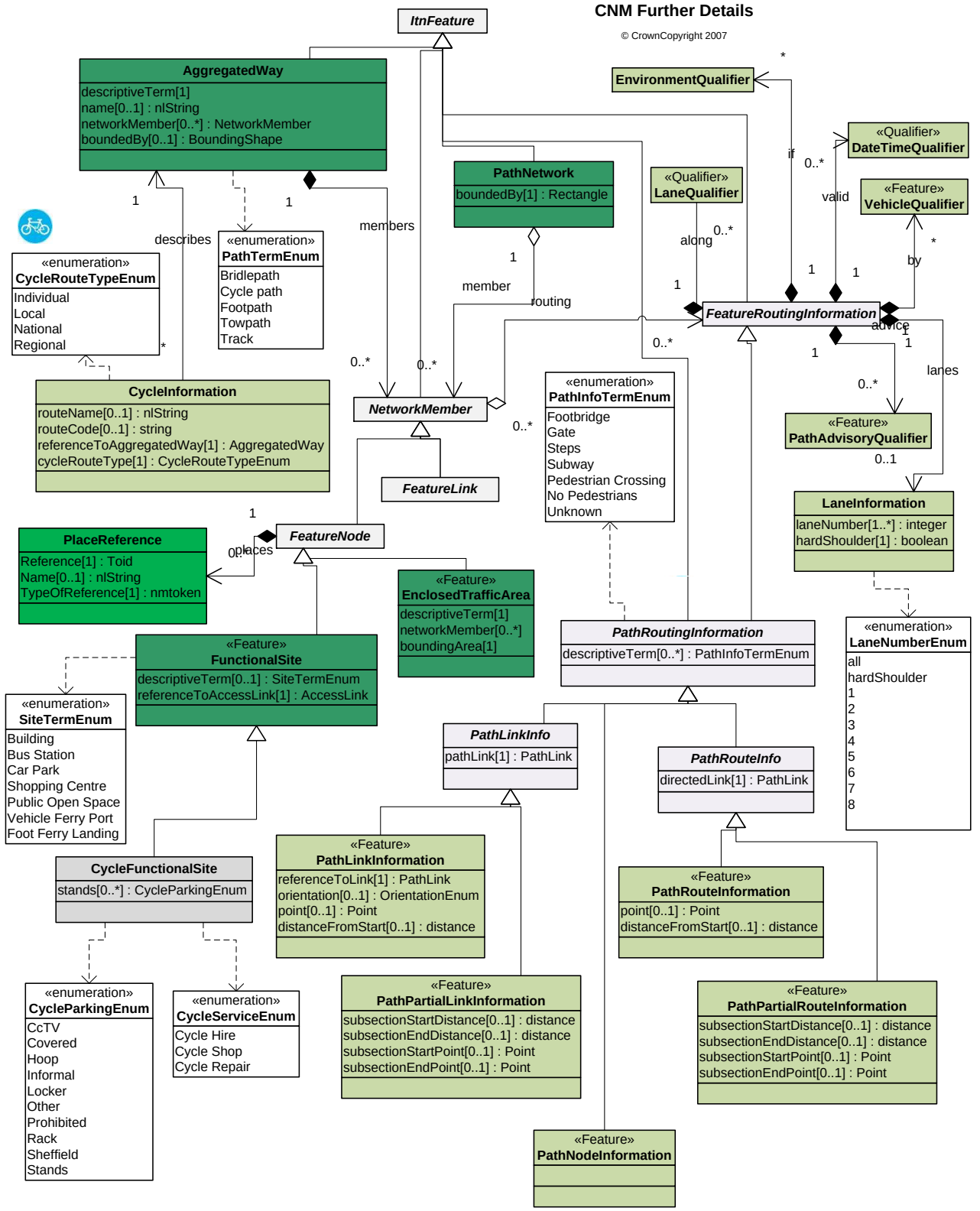

Figure 7-5 UML Diagram of CNM detailed attributes of Routing and Network Elements

Use of Qualifiers at an Aggregated Way Level

Note that if ROUTING ELEMENT qualifiers are associated with an AGGREGATED WAY, they apply to the whole path.

CNM Date Time Qualifier

To specify that a PATH ROUTING INFORMATION only applies at a particular time or on a particular day type (e.g. *Mondays, Bank holidays*, etc) The CNM uses the ITN DATE TIME QUALIFIER. See 0 in ANNEX A & [ITN1].

The ITN values for periods are open ended and unconstrained. In order to ensure that time periods are constrained to well-defined values, the CNM supports an additional element TemporalSpan element, which has enumerated values for commonly found day and period types.

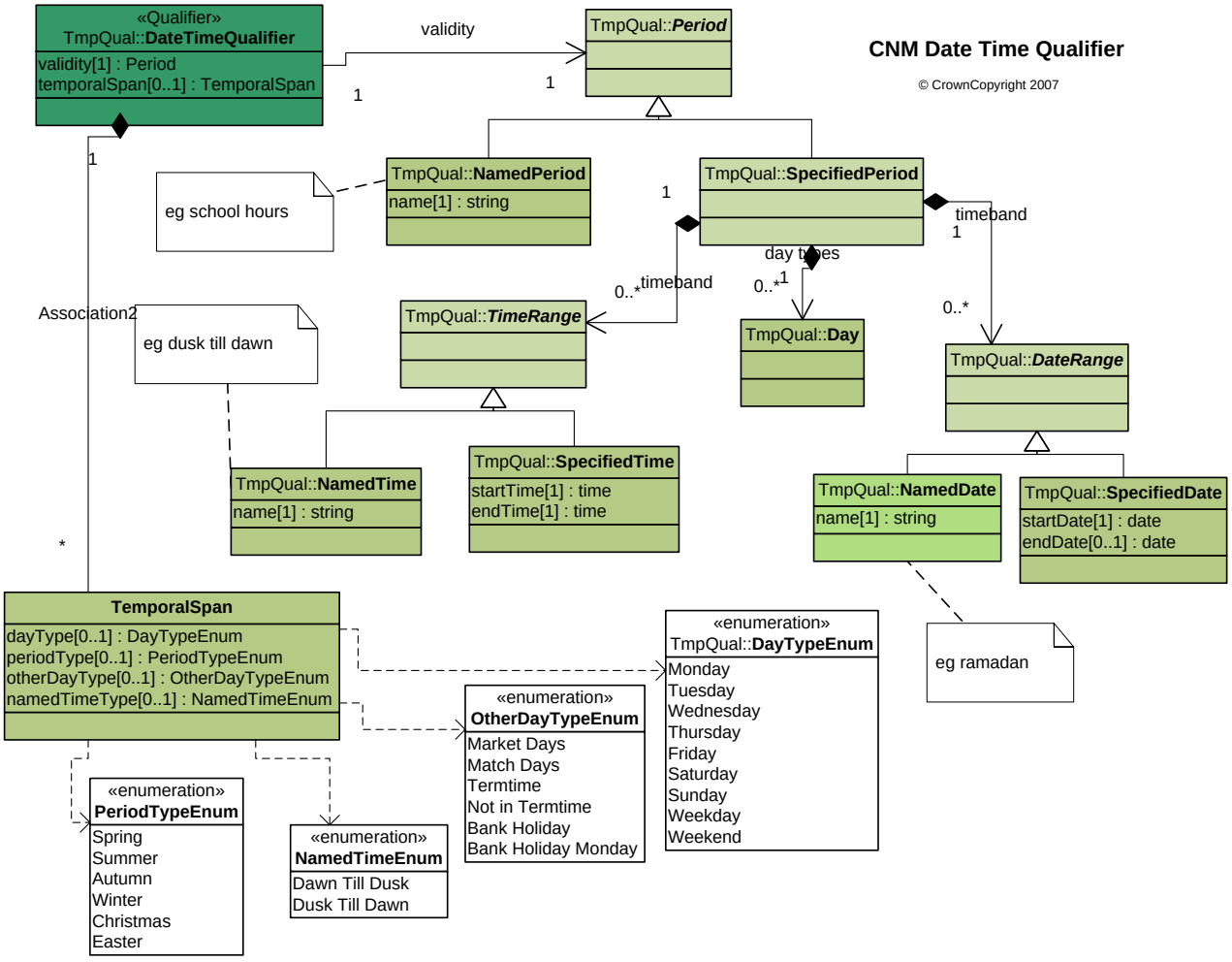

Figure 7-6 CNM Date Time Qualifier

CNM Vehicle Qualifier

To specify that a particular PRI only applies to a particular vehicle type, (cars, buses, cycles, etc), the CNM uses the RN VEHICLE QUALIFIER. See section 0 in ANNEX A & [ITN1].

CNM Environment Qualifier

To specify environmental properties of a particular PRI, for example the gradient or type, the CNM uses the RN ENVIRONMENTAL QUALIFIER. See section 0 in ANNEX A & [ITN1].

The following three attributes are of particular relevance for the CNM:

- INSTRUCTION – Constraints on Traffic Flow, e.g. one-way, two-way.
- CLASSIFICATION – Description of the FEATURE, e.g. *bridge, tunnel, ford, bridge over road, under road.*
- GRADIENT – How steep is the section.

The ITN values for INSTRUCTION, CLASSIFCATION and CONDITION are open ended and unconstrained. In order to ensure that the values are constrained to well-defined values, the CNM supports additional INSTRUCTION TYPE, CLASSIFICATION TYPE and CONDITION TYPE elements, which have enumerated values..

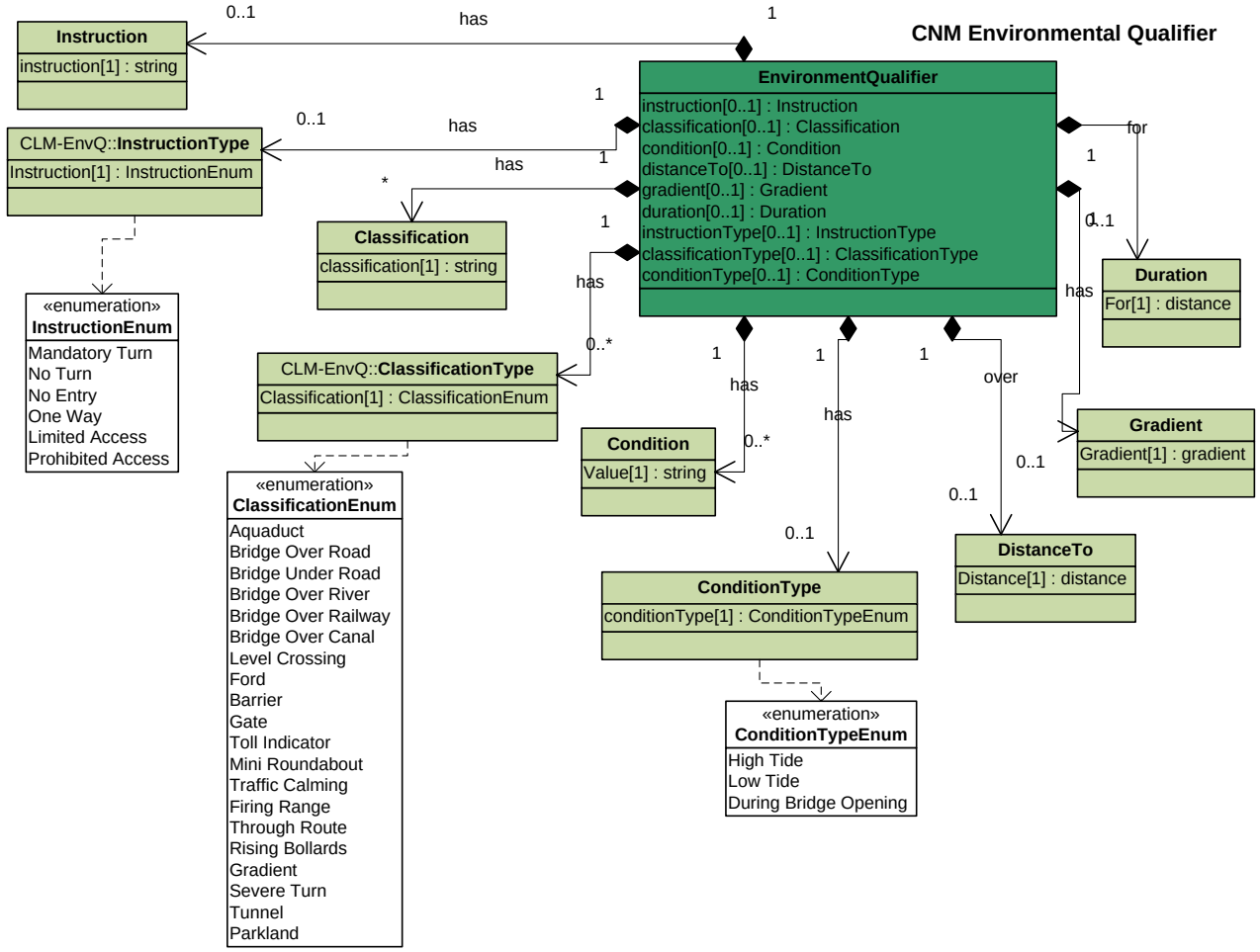

Figure 7-7 CNM Environment Qualifier

CNM Lane Qualifier

Figure 7-8 shows the CNM LANE QUALIFIER element. The LANE QUALIFIER describes path properties that may potentially be distinguished on individual lanes – though equally well may apply to all lanes, It can be used to specify the properties of one or all of the lanes that might affect choice of routing, either along a FEATURE LINK or partial link, or at a FEATURE NODE. It comprises mostly attributes that can be assessed objectively.
Note that the individual lanes that the QUALIFIER applies can be specified by a LANE INFORMATION element.
A VEHICLE QUALIFIER is used in conjunction with the LANE QUALIFIER to indicate restriction to a specific mode e.g. bus, cycle, foot etc.

Lane Properties

- SURFACE. Describes the material of the lane, for example, *cobbles, tarmac*, etc. See Data Attributes.
- TRAFFIC CALMING. Describes the calming measures along the lane, such as *humps* or *cushions*. See Data Attributes.
- CALIMING AVOIDABLE BY CYCLE. Whether the calming measure will affect cyclists.
- CYCLING PROVISION. Indicates the nature of the cycling provision. See Data Attributes.
- CYCLE USE. Indicates whether a cycle can be used on the link or partial link See Data Attributes.

Lane Adornments

- BARRIER. The nature of a barrier located at the indicated point, e.g. *gate, stile,* etc. See Data Attributes.
- CROSSING. The nature of a pedestrian crossing at the indicated point on the link. See Data Attributes. Note that this is to describe the attributes of a crossing: an indication that there is a crossing on a path link can be specified using ITN attributes, e.g. by a PATH INFO TERM attribute of '*pedestrian crossing'* on a PATH ROUTING INFORMATION element.
- TRAFFIC LIGHT. Indicates the presence of a traffic light.
- ADVANCED STOP LINE. Indicates availability of a separate stop line for cyclists across the road.
- SIGNAGE. Describes any specific signs at designated points and their contents.

Lane Volumes

- TRAFFIC SPEED. Describes the speed of traffic with objective measures (the speed limit and the average observed speed); these may be provisioned from an additional source.
- TRAFFIC VOLUME. Describes the amount of traffic; objective measures (the speed limit and the average observed speed); these may be provisioned from an additional source.

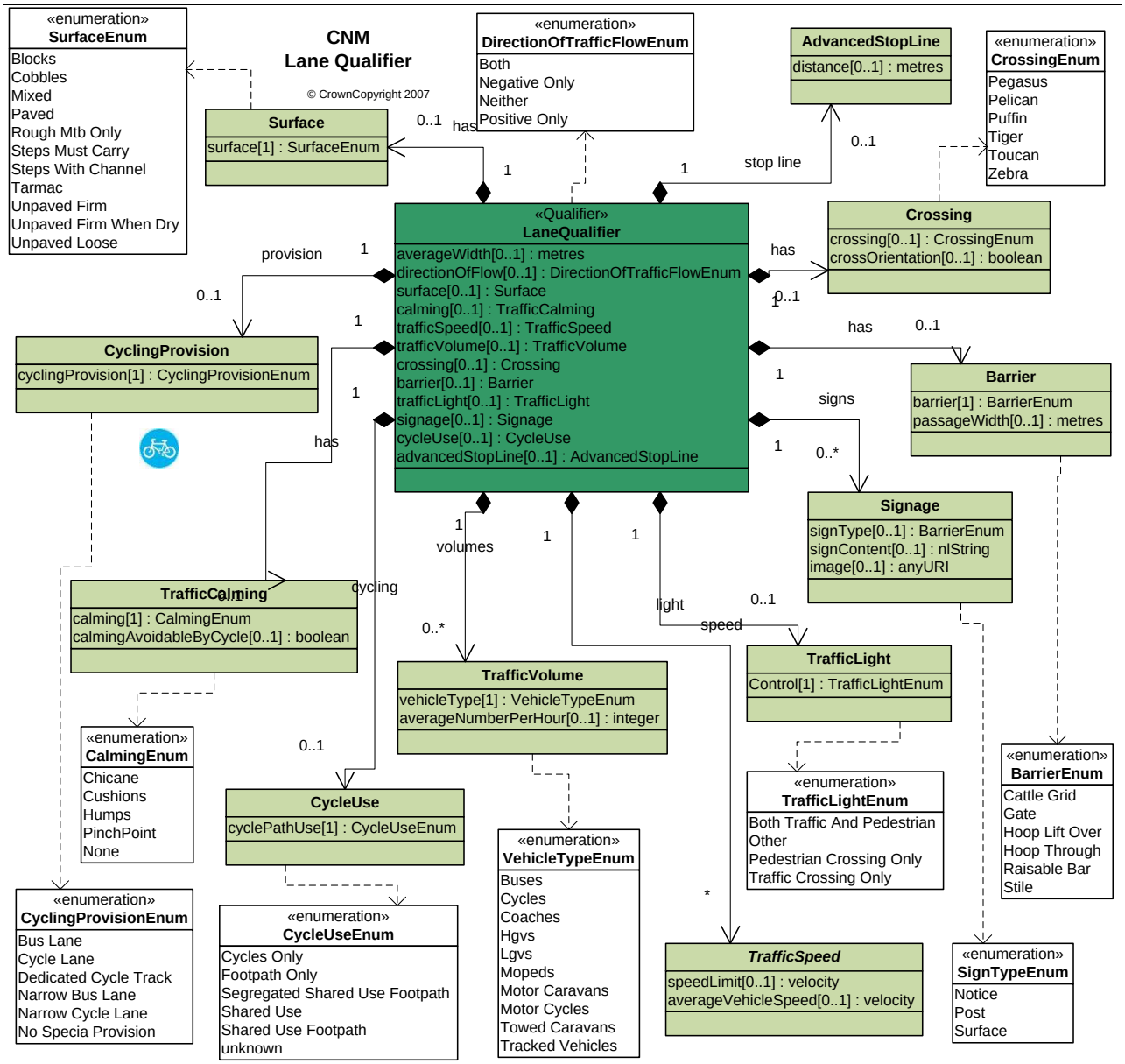

Figure 7-8 UML Diagram of CNM Lane Qualifier

CNM Path Advisory Qualifier

Figure 7-9 shows the CNM PATH ADVISORY elements, which specify attributes affecting the usability of a link or partial link, in particular those affecting the CYCLABILITY. These may be subjective (indicated by a wry smiley or "wriley").

- CYCLING MANOEUVRABILITY. Indicates the Manoeuvrability of the Routing Feature: specified on a ROUTING INFORMATION connecting two links. Has two properties:
  - MANOEUVRABILITY. Rating of manoeuvre.
  - CYCLE INSTRUCTION. Explanation of nature of manoeuvre needed.
- RECOMMENDATION. Specifies whether the path is recommended. See Data Attributes for definitions.
- QUIETNESS. Describes the relative Quietness of a link compared to that expected for its road type. See Data Attributes for definitions.
- EFFORT. Describes the effort required to use the path. See Data Attributes for definitions.
- LIGHTING. Describes the effectiveness of the lighting along the path. See Data Attributes for definitions.
- CONGESTION. Describes the relative congestion of the link compared to that expected for a link of its type. See Data Attributes for definitions.
- PERSONAL SAFETY. Describes personal safety factors. See Data Attributes for definitions.
  - SAFETY REPUTATION. Describes the reputation of a feature for safety.
  - SAFEGUARDs: How well monitored is a route.

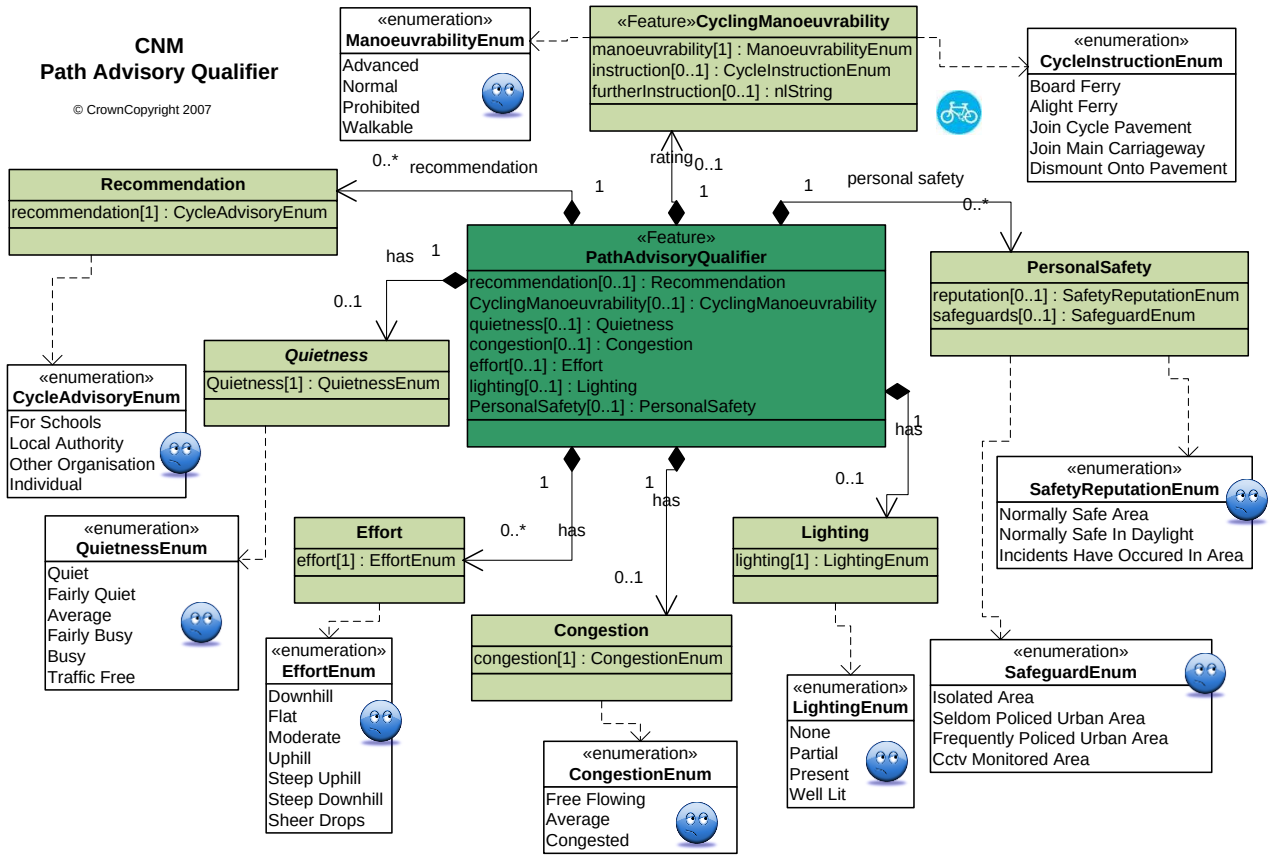

Figure 7-9 UML Diagram of CNM Path Advisory Qualifier

Using Qualifiers

In principle all qualifiers can be used with all ROUTING INFORMATION FEATURES and hence applied to ROADS or PATHS. However some qualifiers are more relevant to certain features. The Qualifiers primary use is illustrated in the table below.

	Qualifiers				
	Date-Time	**Environment**	**Vehicle**	**Lane**	**Path-Advisory**
Link Information	R,P	R,P	R, (P)	R,P	(R), P
Partial Link Information	R,P	R,P	R, (P)	R,P	(R), P
Route Information	R,P	R,P	R, (P)	R,P	(R), P
PartialRoute Information	R,P	R,P	R, (P)	R,P	(R), P
Node Information	R,P	R,P	R, (P)	R,P	(R), P

8. CYCLE NAVIGATION

This section provides a brief discussion on considerations for using CNM data in Trip Planning. It is not part of the model specification itself.

The primary purpose of the CNM data set is to support trip planning for cyclists. A trip planner will use the network and routing data to return suggested itineraries to the cyclist, according the cyclist's own preferences for route optimisation. Common optimisations are for example *fastest*, *shortest*. More complex optimisations might include contour saving to minimise the amount of vertical climbing needed. Other more subjective optimisations are possible for example "*easiest*", "*safest*".

A Cycle Trip Planner will use its own routing and weighting algorithms to assess routes according to the input criteria, matching these to the cycle network data according to its own assessment of relevance. The CNM data model does not need to prescribe these algorithms, nor restrict the possible criteria a trip planner may choose to support.

8.1. Inputs

Most of the data elements shown on the different QUALIFIERS are possible inputs for assessment, either directly or by derivation – for example a busy main road or complex junction could be rated as "expert". Some criteria are objective, others such as some derived values or the explicit values on the PATH ADVISORY QUALIFER are subjective.

The following criteria are specifically relevant

LANE QUALIFIER

- SURFACE. Describes the material of the lane, for example, *cobbles, tarmac*, etc. See Data Attributes.
- TRAFFIC CALMING. Describes the calming measures along the lane, such as *humps* or *cushions*. See Data Attributes.
- CYCLING PROVISION. Indicates the nature of the cycling provision. See Data Attributes.
- CYCLE USE. Indicates whether a cycle can be used on the link or partial link See Data Attributes.
- TRAFFIC SPEED. Describes the speed of traffic with objective measures (the speed limit and the average observed speed); these may be provisioned from an additional source.
- TRAFFIC VOLUME. Describes the amount of traffic; objective measures (the speed limit and the average observed speed); these may be provisioned from an additional source.

PATH ADVISORY QUALIFER

- CYCLING MANOEUVRABILITY. Indicates the Manoeuvrability of the Routing Feature:
- RECOMMENDATION. Specifies whether the path is recommended. See Data Attributes for definitions.
- QUIETNESS. Describes the relative Quietness of a link compared to that expected for its road type. See Data Attributes for definitions.
- EFFORT. Describes the effort required to use the path. See Data Attributes for definitions.
- LIGHTING. Describes the effectiveness of the lighting along the path. See Data Attributes for definitions.
- CONGESTION. Describes the relative congestion of the link compared to that expected for a link of its type. See Data Attributes for definitions.
- PERSONAL SAFETY. Describes the safety factors. See Data Attributes.

8.2. Outputs

A Trip planner will compute in effect a NAVIGATION PATH (though it may use a richer representation to render the results). A NAVIGATION PATH designates the traversal of one or more NETWORK MEMBERs in a particular direction and in a particular sequence.
A CYCLE ROUTE may be composed of one or more NAVIGATION PATHs. (There may be alternative paths within a route). NAVIGATION PATHS may be computed dynamically from the links by a trip planner routing engine, or be stored persistently. **Figure 8-1 shows** the relationship of a navigation path to the fixed elements.

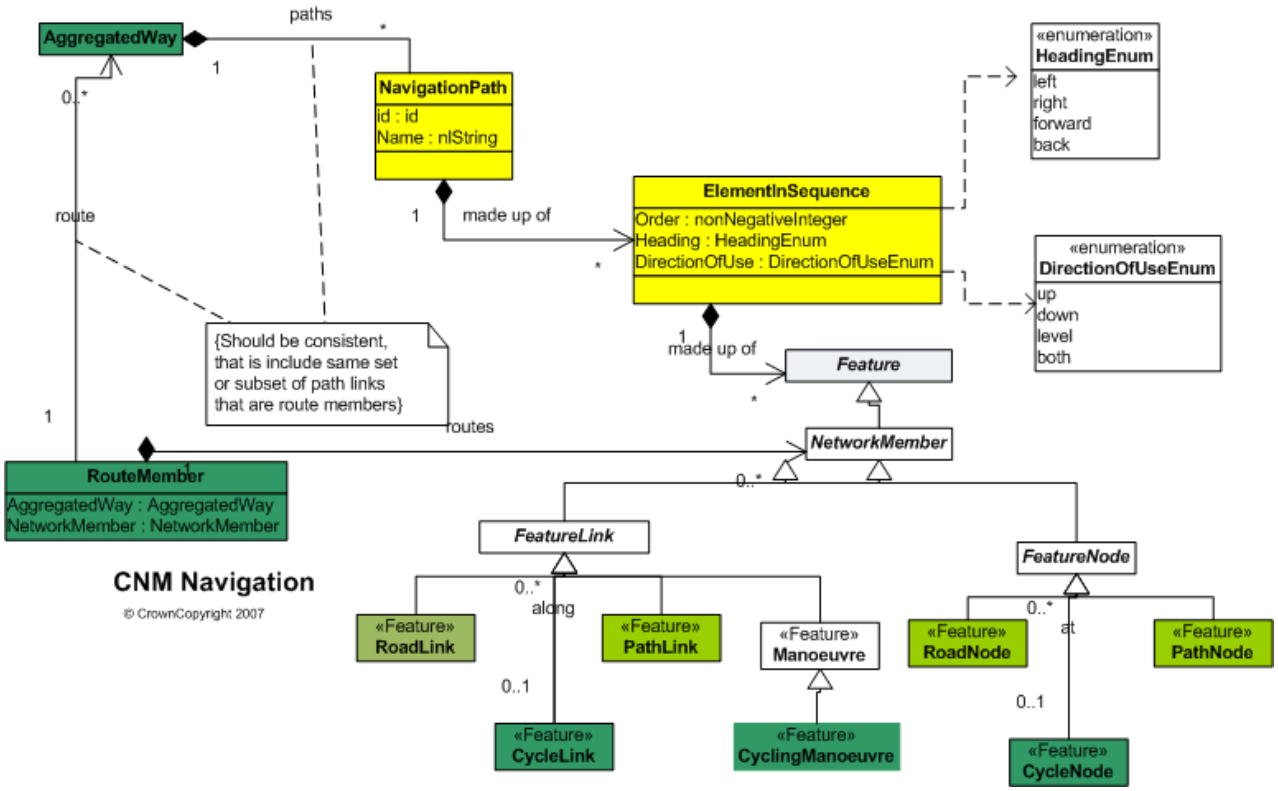

Figure 8-1 UML Diagram of Navigation Path

9. DATA ATTRIBUTES

This section describes various data attributes of the CNM model elements.

It covers primarily the application related elements for which the interpretation for data collection needs to be precise. For details of ITN Road Network and Pedestrian Network attributes, see [ITN1] & [PN1].

The CNM model is designed so that it can be populated to different levels of detail - most of the elements are optional. A separate table is provided indicating whether the attributes are required for the Transport Direct Portal, see section 15.

9.1. Data Attributes

Attribute description	CNM Element	Description	Min: Max	Default if absent
	Abstract Contributor			
Contributor Organisation id	***CNM / Contributor / id***	Unique identifier of CONTRIBUTOR. *Gml:id,* in dnf format 4 + id.	1:1	--
Contributor Type	***CNM / Contributor / contributorType***	Type of organisation that collected the data. • *Community member.* • *Professional organisation.* • *Local Authority.* • *Professional organisation on behalf of Local Authority.* *Unknown.*	0:1	*unknown*
Contributor email	***CNM / Contributor / email***	Contact email for contributor to use to check data, IPR or other issues. *Valid email.*	0:1	none
Contributor Email allowed use	***CNM / Contributor / allowPublishEmail***	Consent as to whether contact email for CONTRIBUTOR can be published publicly. *Boolean*.	0:1	false
Contributor web site	***CNM / Contributor / webSite***	Url for CONTRIBUTOR to find out more about her. *Uri*.	0:1	none
Contributor Note	***CNM / Contributor / note***	Further note about CONTRIBUTOR. *String*.	0:1	none
	Contributor-Organisation			
Contributor Group Name	***CNM / Contributor / Contributor-Organisation / description***	Name of CONTRIBUTOR ORGANISATION. *String.*	0:1	none
Contributor	***CNM /***	Manager of CONTRIBUTOR ORGANISATION. Provides contact	0:1	none

Organisation Manager	***Contributor / Contributor-Organisation / manager***	details for the group as a whole. *Reference* to a CONTRIBUTOR.		
Contributor Organisation Prefix	***CNM / Contributor / Contributor-Organisation / dnfPrefix***	Unique prefix to use to allocate TOIDs for Group data. *String (*preferably limited to NMTOKEN).	1:1	--
	IndividualContributor			
Contributor name	***CNM / Contributor / IndividualContributor / contributorName***	Name of contributor within a CONTRIBUTOR ORGANISATION. *String*.	1:1	--
Contributor Organisation	***CNM / Contributor / IndividualContributor /contributor-Organisation***	CONTRIBUTOR ORGANISATION to which member belongs. *Reference* to a CONTRIBUTOR ORGANISATION.	1:1	
	CommunityRights			
Survey Method	***CNM / CommunityRights / surveyMethod***	How data was collected. • *Ground survey (inspection).* • *Manual desktop survey, using local knowledge, inspecting other data sources.* • *Derived though computation from other data sources.* • *Unknown.* **Notes:** Data license agreements might stipulate that data sources used to derive data are referenced through the data. TBC.	0:1	*unknown*
Verification Status	***CNM / CommunityRights / verificationStatus***	Whether data has been verified and endorsed by the indicated CONTRIBUTOR. • *Unverified.* • *Community Verified.* • *Professionally Verified.* **Notes:** Verification mechanisms and processes have not been defined. This attribute will adapt to support these. TBC.	0:1	*Unverified*
Allowed Use	***CNM / CommunityRights / allowedUse***	How the data can be used. • *Unrestricted use.* • *Not for profit use only.* • *Commercial Licence. Available for use under a commercial licence with data provider/owner.* • *Open Source Licence. Available for use under an open source licence.* **Notes:** Different open source licences might be defined. TBC	0:1	*Open source licence*
IPR Notes Use	***CNM / CommunityRights /***	Further notes comments and terms on IPR. Can be used to record special conditions, etc.	0:1	none

	iprNotes	• String		
	Feature			
Feature	***Feature / id/***	GML Unique identifier of a FEATURE. • Gml id – populated as valid Toid. Use DNF prefix of Community Group .to ensure uniqueness	1:1	--
	Feature / description/	GML Description of feature *String*	0:1	none
	Feature / name	GML Code identifier if feature. (Note that in GML 3. This allows multiple alias for different namespaces).	0:1	none
	Feature / boundedBy/	GML Bounding box of feature. *Gml Box or null.*	0:1	none
	ITN / Feature / featureCode	ITN feature code assigned to element. *Unsigned integer.*	0:1	none
	ITN / Feature / version	Version number of feature data. *Unsigned integer.*		
	ITN / Feature / versionDate	Version date of feature data. *Date*		
	ITN / Feature / theme	ITN Theme to which element belongs: • *Road Network* • *Path Network* • *Cycle Network* **Note** Theme can be used to indicate Cycling related elements.	0:1	*CycleNetwork*
	ITN / Feature / descriptiveGroup	ITN or CNM Descriptive Grouping to which element belongs *Restricted String. – depends on Feature type*	0:1	none
	ITN / Feature / descriptiveTerm	ITN or CNM Descriptive Term to which element belongs. *Restricted String – depends on Feature type*	0:1	none
	CNM / Feature / access/	Whether the element is publicly accessible. • *Public* – There is public access (this may be limited to certain times) • *Private Unrestricted* – The element is private but there is some public access • *Private*– There is not public access	0:1	*public*
Change History	***ITN / Feature / ChangeHistory/***	CNM Date of change. *Date time*	1:1	*none*

	changeDate	*Note:* ITN uses *date*: CNM uses *dateTime*		
	ITN / Feature / ChangeHistory/ reasonForChange	ITN Reason for change. • *Attributes* • *Incomplete* • *Modified* • *New* • *Position* • *Reclassified* • *Restructured* • *Software* • *Text Change*	1:1	*none*
	CNM/ Feature / ChangeHistory / changedBy	CNM contributor who made change. *Reference* to CONTRIBUTOR.	1:1	*none*
	CNM / Feature / ChangeHistory/ role	Role of contributor in making change. • *Supply.* Contributor supplied data. • *Verify.* Contributor verified data. • *Update.* Contributor updated data. • *Aggregate.* Contributor aggregated data. • *Distribute.* Contributor distributor data. • *Owner.* Contributor of data.	0:1	*Supply*
	FeatureInformation			
Feature InfoLink	***CNM / Feature / FeatureInformation / infoLink***	Arbitrary Url that may be associated with a FEATURE. *Uri.*	0:1	none
Feature InfoLink Type	***CNM / Feature / FeatureInformation / infoType***	Indication of content type of an arbitrary Url associated with a FEATURE, e.g. publicity. *String.*	0:1	none
	Road			
Classifiers	***ITN / Road / descriptiveGroup***	ITN Descriptive Grouping to which element belongs. • *Named Road* • *Motorway* • *A Road* • *B Road*	0:1	none

	ITN / Road / descriptiveTerm	ITN Descriptive Term to which element belongs. • *Trunk Road* • *Primary Route*	0:1	none
Cycle Network extent	***ITN RN / Road / boundedBy***	The bounding box for the whole network. *Rectangle.*	0:1	none
Official Road Name	***ITN RN / Road / roadName***	The name assigned to a particular Road by the DfT. *String*.	0:1	none
Members	***ITN RN / Road / networkMember***	ROAD LINKs and other network elements making up the road. *Reference to* network member	1:*	none
	AggregatedWay			
Classifiers	***CNM / AggregatedWay / descriptiveGroup***	CNM Descriptive Grouping to which element belongs. • *Named Path* • *Path*	0:1	none
	ITN / AggregatedWay / descriptiveTerm	CNM Descriptive Term to which element belongs. • *Track* • *Footpath* • *Towpath* • *Bridleway* • *Cyclepath*	0:1	none
Aggregated Way	***CNM / / AggregatedWay / name***	Description of AGGREGATED WAY*:* *String*	0:1	none
Members	***CNM / AggregatedWay / networkMember***	Path LINKs and other network elements making up the way. *Reference to* network member	1:*	none
Aggregated Way extent	***CNM / / AggregatedWay / boundedBy***	The bounding box for the whole aggregated way. *Rectangle*.	0:1	none
	CycleInformation			
Classifier	***CNM / CycleInformation / descriptiveGroup***	CNM Descriptive Grouping to which element belongs. • *Named Path* • *Path*	0:1	none
Cycle Path Name	***CNM / CycleInformation / routeName***	A name assigned to a CYCLE ROUTE i.e. collection of ROAD and PATH LINKS. *String*.	0:1	none

		Notes: Names are usually indicated by signage along the path. A single link may form part of many Aggregated Ways. See CYCLE IINFORMZTION TYPE defining the different types of named Aggregated Ways. An AGGREGATED WAY may have several names, stated as different CyleInformationElements		
Cycle Route label	***CNM / CycleInformation / routeCode***	The code labels of a named AGGREGATED WAY. *String.*	0:1	none
Based on	***CNM / CycleInformation / referenceTo-AggregatedWay***	AGGREGATED WAY. To which this information pertains. *Toid.*	0:1	none
Cycle Route Type	***CNM / / CycleInformation / cycleRouteType***	The type of cycle route of a named AGGREGATED WAY. • *National* Cycle Network, such as Route 4 as defined by Sustrans. NCN paths are indicated by signage. More information is available from Sustrans. • *Regional* Cycle Route, can be defined by Sustrans and/or Region. • *Local* Cycle Route, such as "Tarka Trail", "Phoenix Trail", "Test Way". • *Individual.* Other labelled Cycle routes.	0:1	none
	RoadNode			
Classifiers	***ITN / RoadNode / descriptiveGroup***	CNM Descriptive Grouping to which element belongs. • *Road Topology*	1:1	none
Geometry	***ITN RN / RoadNode / point***	The location of the node. *Point.*	1:1	none
Topography	***ITN RN / RoadLink / referenceTo-TopographicArea***	Reference to a Topographic Area. *Topographic Feature*	0:1	--
	RoadLink			
Form of Way	***ITN RN / RoadLink / descriptiveTerm***	The type of ROAD LINK. • *Motorway.* • *A Road.* • *B Road.* • *Minor Road.* • *Local Street.* • *Alley* • *Private Road – Publicly Accessible*	1:1	--

		• *Private Road – Restricted Access.* • *Pedestrianized Street* **Notes:** Same as for ITN RN		
Form of Way	***ITN RN / RoadLink / natureOfRoad***	The nature of the ROAD LINK. • *Single Carriageway.* • *Dual Carriageway.* • *Slip Road* • *Roundabout.* • *Enclosed Traffic Area Link* • *Traffic Island Link At Junction.* • *Traffic Island Link At* **Notes:** Same as for ITN RN	1:1	--
Geometry	***ITN RN / RoadLink / length***	The length of the ROAD LINK. *length*	1:1	--
	ITN RN / RoadLink / polyline	The geometry of the ROAD LINK. *polyline*	1:1	--
Nodes	***ITN RN / RoadLink / directedNode***	The nodes that the ROAD LINK connects. *DirectedNode to RoadNode*	2:2	--
Topography	***ITN RN / RoadLink / referenceTo-TopographicArea***	Reference to a Topographic Area. *Topographic Feature*	0:1	--
	PathNode			
Classifiers	***ITN / PathNode / descriptiveGroup***	CNM Descriptive Grouping to which element belongs. *Path Topology*	1:1	*Path Topology*
Form of Way	***ITN RN / PathNode / descriptiveTerm***	The type of ROAD LINK. • *Path.* • *Ferry* **Notes:** Same as for ITN PN	0:1	*Path*
Geometry	***ITN RN / PathNode / point***	The location of the node. *Point.*	1:1	none
Topography	***ITN RN / PathNode / referenceTo-TopographicArea***	Reference to a Topographic Area. *Topographic Feature*	0:1	--

Legal	***CNM RN / PathNode / legalRights***	The legal access rights pertaining to the PATH LINK. • *Bridleway* • *Byway Open To All Traffic* • *Footpath* • *Green Lane* • *Pavement Footway* • *Permissive Path* • *Restricted Byway* • *Road Used As A Public Path* *Unknown*	0:1	*Unknown*
	PathLink			
Classifiers	***ITN / PathLink / descriptiveGroup***	ITN Descriptive Grouping to which element belongs. *Path Topology*	1:1	none
Path Term	***ITN PN / PathLink / / descriptiveTerm***	The type of PATH LINK. • *Footpath.* Path suitable and restricted to passage on foot. Cyclists must dismount. • *Cyclepath.* Path suitable for Cyclists. • *Bridlepath.* Right of way where foot, cycle and horse riding is permitted. • *Towpath.* Right of way beside course of water where foot, cycle and horse riding is permitted. • *Track,* Right of way where cyclists and walkers are permitted. Usually earth or uneven surface, see surface definition. • *Unknown.* **Notes:** Same as for ITN PN.	1:1	--
Make of Path	***ITN PN / PathLink / make***	The nature of the make of the PATH LINK. • *Manmade* Path is Man made. • *Natural:* Path is natural. • *Multiple.* Path has both natural and manmade sections. **Notes:** Same as for ITN PN.	0:1	*Man Made*
Geometry	***ITN RN / PathLink / length***	The length of the ROAD LINK. *length*	1:1	--
	ITN RN / PathLink / polyline	The geometry of the ROAD LINK. *polyline*	1:1	--

Nodes	***ITN RN / PathLink / directedNode***	The nodes that the ROAD LINK connects. *DirectedNode to RoadNode*	2:2	--
	ITN RN / PathLink / gradeSeparation	Logical level of link when there are two or more paths crossing at the same time.	0:1	--
Legal	***CNM RN / PathLink / legalRights***	The legal access rights pertaining to the PATH LINK. • *Bridleway* • *Byway Open To All Traffic* • *Footpath* • *Green Lane* • *Pavement Footway* • *Permissive Path* • *Restricted Byway* • *Road Used As A Public Path* • *Unknown*	0:1	*Unknown*
Topography	***ITN RN / PathLink / referenceTo-TopographicArea***	Reference to a Topographic Area. *Topographic Feature*	0:1	--
Abstract	***RoutingInformation***	Common routing Info		
Classifiers	***ITN / RoutingInformation / descriptiveGroup***	ITN Descriptive Grouping to which element belongs. • *Road Topology* • *Path Topology*	1:1	none
Lane	***CNM PN / RoutingInformation / laneInformation***	The LANE to which routing information applies of PATH LINK. If unspecified applies to all lanes *LaneInformation*	0:1	*All lanes*
Path Term	***ITN PN / PathLinkInformation / descriptiveTerm***	The nature of Path Routing Information type • *Footbridge.* • *Gate.* • *Steps.* • *Subway.* • *Pedestrian Crossing.* • *No Pedestrians.* • *No Cycling.* • *Unknown.*	1:1	--

		Notes: Same as for ITN PN		
Qualifier	***ITN PN / RoutingInformation / DateTimeQualifier***	Any DATE TIME QUALIFIER that applies to the ROUTING INFORMATION. *DateTimeQualifier* Note multiple instances of a ***DateTimeQualifier*** are logically ORed together. The ***DateTimeQualifier*** is logically ANDed together with other Qualifier types.	0:*	*none*
	ITN PN / RoutingInformation / VehicleQualifier	Any VEHICLE QUALIFIER that applies to the ROUTING INFORMATION. *VehicleQualifier* Note multiple instances of a ***VehicleQualifier*** are logically ORed together. The ***VehicleQualifier*** is logically ANDed together with other Qualifier types.	0:*	*none*
	ITN PN / RoutingInformation / EnvironmentQualifier	Any ENVIRONMENT QUALIFIER that applies to the ROUTING INFORMATION. *EnvironmentQualifier* Note multiple instances of a ***EnvironmentQualifier*** are logically ORed together. The ***EnvironmentQualifier*** is logically ANDed together with other Qualifier types.	0:*	*none*
	CNM PN / RoutingInformation / LaneQualifier	Any LANE QUALIFIER that applies to the ROUTING INFORMATION. *LaneQualifier* Note multiple instances of a ***LaneQualifier*** are logically ORed together. The ***LaneQualifier*** is logically ANDed together with other Qualifier types.	0:*	*none*
	CNM PN / RoutingInformation / PathAdvisory-Qualifier	Any PATH ADVISORY QUALIFIER that applies to the ROUTING INFORMATION. *PathAdvisoryQualifier* Note multiple instances of a ***PathAdvisoryQualifier*** are logically ORed together. The ***PathAdvisoryQualifier*** is logically ANDed together with other Qualifier types.	0:*	*none*
	RoadNode-Information			
Base	***ITN RN / RoadNode-Information / referenceTo-RoadNode***	ROAD NODE to which information applies. *RoadNode*	1:1	--
	RoadLinkInformation			
Base	***ITN RN / RoadLinkInformation / referenceTo-RoadLink***	ROAD LINK to which information applies. *NetworkLink* i.e. *RoadLink* or *FerryLink*	1:1	--
Geometry	***ITN RN / RoadLinkInformation / distanceFromStart***	The distance of the information along link, if relevant.. *Distance.*	0:1	none

	ITN RN / RoadLinkInformation / point	The location of the information, if relevant.	*Point.*	0:1
	RoadRoute-Information			
Base	***ITN RN / RoadRoute-Information / referenceTo-RoadLink***	ROAD LINK to which information applies. *DirectedLink i*.e. *RoadLink* or *FerryLink + direction*	1:1	--
Geometry	***ITN RN / RoadLinkInformation / distanceFromStart***	The distance of the information along link, if relevant.. *Distance.*	0:1	none
	ITN RN / RoadRoute-Information / point	The location of the information, if relevant. *Point.*	0:1	none
	PathNodeInformation			
Base	***ITN PN / PathNodeInformation / referenceToNode***	PATH NODE to which information applies. *PathNode*	1:1	--
	PathLinkInformation			
Path Info Term	***ITN PN / PathLinkInformation / referenceToLink***	The PATH LINK .to which information applies. *NetworkLink.* (ie *RoadLink* or *FerryLink*)	1:1	--
Geometry	***ITN PN / PathLinkInformation / orientation***	The end from the path link at which the information applies. • '-' *Origin* • *'+' Destination*		
	ITN PN / PathLinkInformation / distanceFromStart	The distance along the PATH LINK .to which information applies *Distance*		
	ITN PN / PathLinkInformation / point	The location of the information, if relevant. *Point.*	0:1	none
	DateTimeQualifier			
Validity Condition	***CNM / RRI & PRI / DateTimeQualifier / Day , etc***	The period in which the function of an associated feature or relationship is available to the public. This may be expressed in terms of day types (e.g. *Monday to Fridays*, not *public holidays*), and or time bands e.g. *7am-9pm*). If not present, assume access at all times. **Notes:** This is relevant to paths through parks and pedestrian areas. Times will be displayed on signage at entrance to/exit from these areas. Data should be available from Local Authority and/or organisation responsible for the feature.	0:1	always
	Environmental-Qualifier			

Instruction	***CNM / RRI & PRI / Environmental-Qualifier / instructionType***	Turn Instruction. This may be further refined or overridden by an instruction on a CYCLING MANOEUVRABILITY. • *Mandatory Turn.* • *No Turn.* • *No Entry.* • *One Way.* • *Limited Access.* • *Prohibited Access.*	0:1	none
Section Classification	***CNM / RRI & PRI / Environmental-Qualifier / classificationType***	Describes known environmental conditions useful for routing. • *Bridge Under Road.* • *Level Crossing.* • *Ford.* • *Barrier.* • *Gate.* • *Toll Indicator.* • *MiniRoundabout.* • *Traffic Calming.* • *Firing Range.* • *Through Route.* • *Rising Bollards.* • *Gradient.* • *Severe Turn.* • *Tunnel.* Available in RN data set	0:*	none
Section Classification	***CNM / RRI & PRI / Environmental-Qualifier / conditionType***	Describes known environmental conditions useful for routing. • *High tide* • *Low tide.* • *During Bridge Opening.*	0:*	none
Gradient	***CNM / RRI & PRI / Environmental-Qualifier / gradient***	The road gradient percentage value on the ROAD/PATH LINK. The gradient is expressed in the form of a percentage incline. Negative values describe downhill gradients, positive values describe uphill gradients. Gradients are measured in the positive direction. Only the maximum gradient value at any position along the *Road/Path Link* is captured. **Notes:** This objective data will be inferred from a 3rd party height	0:1	level

		dataset and not collected via survey. Altitude and Profile data may also be represented in model but will be collected separately.		
	LaneInformation			
Lane Number	***CNM / PRI / LaneInformation / laneNumber***	The lane of a ROAD LINK to which a QUALIFIER applies. • *Integer, lane number* 1=Nearside, 2= second from Nearside, etc.	0:1	All lanes
Lane type	***CNM / PRI / LaneInformation / hardShoulder***	Other types of LANE to which a QUALIFIER applies. • *Normal.* • *HardShoulder.*	1:0	*normal*
	LaneQualifier			
Lane Width	***CNM / RRI & PRI / LaneQualifier / averageWidth***	Average total width of a LANE or LANEs associated with a ROUTING INFORMATION of PATH LINK(s) or ROAD LINK(s). Expressed in metres. This might not represent the width available for cyclist due to traffic, park cars etc.	0:1	none
Direction of Cycle Flow	***CNM / RRI & PRI / LaneQualifier / directionOfFlow***	The direction(s) of cyclist flow on a LANE or LANEs associated with a ROUTING INFORMATION of PATH LINK(s) or ROAD LINK(s). • *Allowed in both directions.* • *Closed in positive direction.* • *Closed in negative direction.* • *Closed in both directions.* If not present, Direction of Cycle Flow is the same as the DIRECTION OF TRAFFIC FLOW specified by the ENVIRONMENTAL QUALIFIER / INSTRUCTION	0:1	As for referenced road / path
Surface	***CNM / RRI & PRI / LaneQualifier / surface***	The surface of a LANE or LANEs associated with a ROUTING INFORMATION of a PATH LINK or ROAD LINK. • *Tarmac* • *Paved, good for bikes in good or poor conditions* • *Cobbles, not good for bikes* • *Unpaved firm, passable by most ordinary cyclists* • *Unpaved loose, passable by mountain bikes only* • *Unpaved firm when dry, passable by mountain bikes in dry weather only* • *Steps, cyclists would need to carry their bike.* • *Steps with channel, includes a channel to wheel bike*.	0:1	*tarmac*
Traffic Calming	***CNM / RRI & PRI / LaneQualifier / calming***	The traffic calming measures of a LANE or LANEs associated with a ROUTING INFORMATION of PATH LINK(s) or ROAD LINK(s). • *Humps. Bike cannot avoid.* • *Cushions, Bikes may avoid.*	0:1	*none*

		• *Chicane, Bike must swerve* • *None.*		
	CNM / RRI & PRI / LaneQualifier / calmingAvoidable-ByCycle	Whether the traffic calming measures of a LANE or LANEs can be avoided by a bicycle *boolean.*	0:1	*false*
Speed Restrictions	***CNM / RRI / LaneQualifier / TrafficSpeed / speedLimit***	Objective measure of the maximum speed limit allocated to a LANE or LANEs associated with a ROUTING INFORMATION of PATH LINK(s) or ROAD LINK(s). This is the legal speed limit in miles per hour and will only be present in data if known. Might be sourced from commercial sources or HA Can be applied to a single lane or all lanes. **Notes:** This data might be sourced, stored and maintained as a separate dataset to the CNM. TBC	0:1	unknown
Speeds	***CNM / RRI / LaneQualifier / TrafficSpeed / averageVehicle-Speed***	Objective measure of the average speed of vehicles travelling along a LANE or LANEs associated with a ROUTING INFORMATION of PATH LINK(s) or ROAD LINK(s). This is the average speed limit in miles per hour and will only be present in data if known. Might be sourced from commercial sources or HA Can be applied to a single lane or all lanes. **Notes:** This data might be sourced, stored and maintained as a separate dataset to the CNM. TBC	0:1	Unknown.
Number of passing vehicles	***CNM / RRI & PRI / LaneQualifier / TrafficVolume / vehicleTypeur***	Vehicle Type for traffic volume **Notes:** This data might be sourced, stored and maintained as a separate dataset to the CNM. TBC	0:1	unknown
	CNM / RRI & PRI / LaneQualifier / TrafficVolume / averageNumber-PerHour	Objective measure of the average number of vehicles passing along a LANE or LANEs associated with a ROUTING INFORMATION, per unit of time, in the direction of flow. Can be applied to a single lane or all lanes. Can be broken down by vehicle type using the Vehicle enumeration. **Notes:** This data might be sourced, stored and maintained as a separate dataset to the CNM. TBC	0:1	unknown
Crossing Type	***CNM / RRI & PRI / LaneQualifier / crossing***	Defines a FEATURE associated with a ROUTING INFORMATION as a part of a road crossing • *Toucan/Pegasus.* Signal controlled crossing for cyclists and pedestrians. • *Pelican/Puffin.* Signal controlled crossing for pedestrians, cyclists must dismount. • *Zebra.* Crossing without signals, designated for pedestrians, cyclists must dismount. • *Pegasus*. Signal controlled crossing for cyclists, horses	0:1	*zebra*

		and pedestrians. • *Tiger.* Crossing without signals, designated for pedestrians and cyclists. **Notes:** Cycle only signalled crossings also exist; these may run parallel to pedestrian crossings. These should be modelled as Toucan/Pegasus crossings. TBC.		
Barrier	***CNM / RRI & PRI / LaneQualifier / barrier***	Barrier affecting the flow of cycle traffic at a fixed location along a FEATURE associated with a ROUTING INFORMATION of a PATH LINK or ROAD LINK. As a result a dismount or careful manoeuvre might be required. It is assumed that the barrier is passable by cyclists. No special distinction for tandems and trailers is made. • *Chicane.* Narrowing of cycleway • *Gate.* Hanging gate that needs to be opened. • *Stile.* Step that must be climbed over. • *Cattle grid.* Section of open bars over open pit • *Hoop, can get adult bike through.* • *Hoop, must lift adult bike over.*	0:1	none
Traffic Light Control	***CNM / RRI & PRI / LaneQualifier / TrafficLight / control***	Specifies the presence of a Traffic light and whether it Traffic Light controls the following. • *Both Traffic and Pedestrians.* Light controls crossing of both road traffic and pedestrians at junction. • *Traffic Crossing Only* Light controls crossing of road traffic, but not pedestrians. • *Pedestrian Crossing Only* Light controls crossing of pedestrians. • Other: Other types of traffic, e.g. rail, boat	0:1	none
Traffic Light Control	***CNM / RRI & PRI / LaneQualifier / TrafficLight / signage***	Specifies the nature and content of a sign. *Signage*	0:1	none
Cycling Provision	***CNM / RRI & PRI / LaneQualifier / cyclingProvision***	Provision of cycling of a LANE or LANEs associated with a ROUTING INFORMATION of PATH LINK(s) or ROAD LINK(s).. • *No Special provision.* • *Cycle lane.* Painted cycle lane on the road with a width of 1.5 metres or more. • *Narrow cycle lane.* Painted cycle lane on the road less than 1.5 metres wide. • *Bus lane.* Width of 4.2 metres or more. • *Narrow bus lane.* Less than 4.2 metres wide. • *Dedicated Cycle Track.* Specifically designed for cycling, usually two-way. Ideally 3 metres wide, but often less. This is not segregated from the Road and there is access from the Cycle Track to the road along its length.	0:1	*No Special provision*

Path Use	***CNM / RRI & PRI / LaneQualifier / cycleUse***	Classification of how a FEATURE LINK can be used • *Footpath only.* Path suitable and restricted to passage on foot. Cyclists must dismount. Presence of this classification does not indicate whether access by bike is possible. • *Shared use footpath.* A path where cycling is permitted and is shared with walkers. Permit to cycle is indicated by either signage or road markings. • *Shared use segregated cycle path.* A path where cycling is segregated from walkers, usually by way of line on ground. Permit to cycle is indicated by either signage or road markings. • *Shared use.* Bridleway, track right of way where foot, cycle and horse riding is permitted as well as pedestrian use. **Notes:** This objective data will be inferred from a 3rd party height dataset and not collected via survey.	0:1	*shared use*
Advanced Stop Line	***CNM / RRI & PRI / LaneQualifier / advancedStopLine Distance***	Distance advanced stop line is ahead of other stop lines. *Distance* Expressed in metres.	0:1	unknown
	PathAdvisory Qualifier			
Recommended Cycle Routes Subjective	***CNM / RRI & PRI / PathAdvisory Qualifier / recommendation***	Several types of recommended level which can be applied to the FEATUREs associated with a ROUTING INFORMATION. • *National Advisory.* Endorsed by a National organisation, e.g. Sustrans • *Local Authority* Advisory. Endorsed by local authority. • *Local Cyclist Advisory*. Endorsed by local cyclists. • *Individual.* Endorsed by an individual contributor. • *School Route:* Recommended for use in cycle to school.	0:1	none
Advice	***CNM / RRI & PRI / PathAdvisory Qualifier / Cycling-Manoeuvrability***	Manoeuvrability of point at which inforomation applies. *CyclingManoeuvrability*	0:1	--
Quietness Subjective	***CNM / RRI & PRI / PathAdvisory Qualifier / quietness***	Quietness metric relative to normal expectation of road type. E.g. an A Road will be assumed to be busy, but if it is less than expected it can be flagged using this attribute. • *Quiet.* Road is normally quieter than average for a road of its type. • *Average.* Quietness of road is normally average for a road of its type • *Busy.* Road is normally busier than average for a road of its type. • *TrafficFree:* Road has no car traffic (This may also be	0:1	*average*

		indicated by a VehicleQualifier/use value)		
Cycle Congestion Subjective	***CNM / RRI & PRI / PathAdvisory Qualifier / congestion***	Defines whether flow for cycles along section is impeded by dense traffic and narrow lanes. - *Free Flowing*. Flow is better than normal for road type. - *Average.* Flow is normal for road type. - *Congested.* Flow is significantly worse than normal for road type, e.g. overtaking or use of cycle lanes is difficult. **Notes:** May also be caused by cycle jams.	0:1	*average*
Cycle Effort Subjective	***CNM / RRI & PRI / PathAdvisory Qualifier / effort***	Indicates effort required to use along section. - *Flat.* Section is mostly level. - *Moderate.* Section has some gentle inclines. - *Uphill.* Section has pronounced uphill section - *Steep Uphill* Section has very steep sections where many cyclists will dismount. - *Downhill.* Section has pronounced downhill section - *Steep Downhill* Section has very steep downhill sections requiring care to check speed. - *Sheer Drops*. Section has unfenced sheer drops requiring caution, e.g. on hill road or towpath.	0:1	unknown
Lighting Subjective	***CNM / RRI & PRI / PathAdvisory Qualifier / lighting***	Defines whether lighting is present on the FEATUREs associated with a ROUTING INFORMATION, and the extent to which the element is lit. - *None. N*o lighting along the feature. - *Present.* Lights are present but effectiveness not observed working. - *Partial.* Lighting along the feature has been observed working and provides some illumination - *Well Lit.* Lighting along the feature has been observed working and provides well lit path. **Notes:** Default type is defined as unknown but a Trip Planner could assume that all *Road Links* in urban areas are lit.	0:1	unknown
Personal Safety Subjective	***CNM / RRI & PRI / PathAdvisory Qualifier / PersonalSafety / reputation***	Defines whether a user's personal safety may be considered to be at possible risk along the FEATUREs associated with a ROUTING INFORMATION. - *Normally Safe.* Area is not known to be dangerous - *Normally Safe in Daylight.* Area is not known to be dangerous. - *Incidents have occurred in Area*. Area has a heightened risk level and incidents with cyclists have occurred. **Notes:** This is provided as a placeholder. The above definitions are not necessarily complete.	0:1	unknown

Safeguard Subjective	***CNM / RRI & PRI / PathAdvisory Qualifier / safeguard***	Defines whether a user's personal safety is considered at risk along the FEATUREs associated with a ROUTING INFORMATION. - *Isolated Area.* Area is remote from any assistance, for example a park. - *Seldom Policed Area.* An urban area where police support is known to be intermittent. - *Frequently Policed Area.* Area has frequent police patrols which may deter crime. - *CCTV monitored area*. Area is monitored by CCTV which may deter crime. **Notes:** This provided as a placeholder. The above definitions are not necessarily distinct or complete.	0:1	unknown
	Cycling-Manoeuvrability			
Cycling Manoeuvrability Rating Subjective	***CNM / PathAdvisory / Cycling-Manoeuvrability / manoevrability***	Rating difficulty of a manoeuvre to a cyclist. • *Normal*. Manoeuvre is considered to be acceptable for all cyclists. • *Advanced*. Manoeuvre is only considered suitable for competent cyclists. May be dangerous for inexperienced cyclists. Will likely produce a delay to journey for experienced cyclists. • *Dismount*. Manoeuvre only possible if cyclist dismounts. • *Prohibited*: Manoeuvre not allowed. **Notes:** Presence of attributes assumes that the manoeuvre is not considered safe/good for all levels of cyclist. It is assumed that cyclists can make the manoeuvre, banned manoeuvres are modelled elsewhere.	0:1	*Normal*
Cycling Manoeuvrability Instruction Subjective	***CNM / PathAdvisory / Cycling-Manoeuvrability / instruction***	Further Instruction on a manoeuvre for cyclist. • *Join Cycle Pavement*. Manoeuvre involves joining the cycle way. • *Join Main Carriageway*. Manoeuvre involves joining the main carriageway. • *Dismount Onto Pavement* Manoeuvre involves dismounting onto pavement. • *Board Ferry*: Manoeuvre involves boarding a ferry. • *Alight from Ferry*: Manoeuvre involves alighting from a ferry. **Notes:** Presence of attributes assumes that the manoeuvre is not considered safe/good for all levels of cyclist. It is assumed that cyclists can make the manoeuvre, banned manoeuvres are modelled elsewhere.	0:1	unknown
	Signage			

Sign type	***CNM / LaneQualifier / signType***	Further Instruction on a manoeuvre for cyclist. • *Notice*. Sign is on notice. • *Post*. Sign is on post. • *Surface*. Sign is on road surface.	1:1	
Sign content	***CNM / LaneQualifier / signContent***	Content of sign. *Language Qualified String*	0:1	
	CNM / LaneQualifier / infoLink	Further sign content *StrngOrRefType* Url or string	0:1	
	CyclingParking			
Cycling Parking	***CNM / CycleParking / ParkingType***	Nature of Cycle Parking (more than one allowed). • *Stands.* There are free standing stands • *Rack* There is a wheel rack. • *Other*: Cyclists may use railings, etc • *Prohibited*: Cycle Parking not allowed. • *ccTV*. Parking is monitored. • *covered*. Parking is covered.	0:*	unknown
	PlaceReference			
Place Reference	***CNM / PlaceReference / Reference /***	Identifier of a related REFERENCE Object. • Identifier, e.g. NaPTAN co9de	0:1	unknown
Place Name	***CNM / PlaceReference / Name /***	Name of a related REFERENCE Object. • NL String	0:1	unknown
Place Type	***CNM / PlaceReference / TypeReference /***	Type of a related REFERENCE Object. • String,	0:1	unknown

9.2. Core Node & Link Feature Types with Geometry

Group	Attribute	Model	Road Link	Road Node	Path Link	Path Node	Offset Path Link	Offset Path Node
Life Cycle	**Version**	ITN	Y	Y	Y	Y	Y	Y
	Version Date	ITN	Y	Y	Y	Y	Y	Y
	Change Date	ITN	Y	Y	Y	Y	Y	Y
	Reason for Change	ITN	Y	Y	Y	Y	Y	Y
	Changed By	ITN	Y	Y	Y	Y	Y	Y
Community Rights	**Contributor**	CNM	Y	Y	Y	Y	Y	Y
	Allowed Use	CNM	Y	Y	Y	Y	Y	Y
	Verifcation_i	CNM	Y	Y	Y	Y	Y	Y
	Survey Method	CNM	Y	Y	Y	Y	Y	Y
	IPR Notes	CNM	Y	Y	Y	Y	Y	Y
Feature	**Descriptive Group**	ITN	Y	Y	Y	Y	Y	Y
	Descriptive Term	ITN	Y	--	Y	--	Y	--
	Theme	ITN	Y	Y	Y	Y	Y	Y
	Access Type	ITN	Y	Y	Y	Y	Y	Y
	Feature Information	CNM	Y	Y	Y	Y	Y	Y
	Legal Access	CNM	Y	Y	Y	Y	Y	Y
Identity	**Toid**	ITN	Y	Y	Y	Y	Y	Y
Geometry	**Point**	ITN	--	Y	--	Y	--	-
	Polyline	ITN	Y	--	Y	--	-	--
	Length	ITN	Y	--	Y	--	-	--
	Altitude	CNM	--	Y	-	Y	-	Y
	Profile	CNM	Y	-	Y	-	Y	-
Directed Node	**Grade Separation**	ITN	Y	-	Y	--	Y	--
Feature Link	**Directed Node**	ITN	Y	--	Y	--	Y	--
Projection	**Reference to Topographic Area**	ITN	Y	Y	Y	Y	Y	Y
	Reference to Node	ITN	--	--	--	Y	--	Y
	Reference to Link	ITN	--	--	--	--	Y	--

Table 9-1 Attributes of core CNM Features

9.3. Other Node & Link Feature Types with Geometry

Group	Attribute	Model	Access Link	Access Node	Connecting Link	Connect-ing Node	Functional site
Life Cycle	**Version**	ITN	Y	Y	Y	Y	Y
	Version Date	ITN	Y	Y	Y	Y	Y
	Change Date	ITN	Y	Y	Y	Y	Y
	Reason for Change	ITN	Y	Y	Y	Y	Y
	Changed By	ITN	Y	Y	Y	Y	Y
Community Rights	**Contributor**	CNM	Y	Y	Y	Y	Y
	Allowed Use	CNM	Y	Y	Y	Y	Y
	VerificationStatus	CNM	Y	Y	Y	Y	Y
	Survey Method	CNM	Y	Y	Y	Y	Y
	IPR Notes	CNM	Y	Y	Y	Y	Y
Feature	**Descriptive Group**	ITN	Y	Y	Y	Y	Y
	Theme	ITN	Y	Y	Y	Y	Y
	Access Type	ITN	Y	Y	Y	Y	Y
	Feature Information	CNM	Y	Y	Y	Y	Y
Identity	**Toid**	ITN	Y	Y	Y	Y	Y
Geometry	**Point**	ITN	--	Y		(y)	--
	Polyline	ITN	Y	--	(y)	--	--
	Length	ITN	Y	--	(y)	--	
Directed Node	**Grade Separation**	ITN	--	--	Y	--	--
Feature Link	**Directed Node**	ITN	---	--	(y)	--	--
Projection	**Reference to Topographic Area**	ITN	Y	Y	--	--	--
	Reference to Node	ITN	--	Y	--	Y	--

Table 9-2 Attributes of core CNM Features

9.4. Composite Feature Types referencing Geometry

Group	Attribute	Model	Road	Aggregated Way	Path Network
Life Cycle	**Version**	ITN	Y	Y	Y
	Version Date	ITN	Y	Y	Y
	Change Date	ITN	Y	Y	Y
	Reason for Change	ITN	Y	Y	Y
	Changed By	CNM	Y	Y	Y
	Contributor role	CNM	Y	Y	Y
Community Rights	**Contributor**	CNM	Y	Y	Y
	Allowed Use	CNM	Y	Y	Y
	Verification Status	CNM	Y	Y	Y
	Survey Method	CNM	Y	Y	Y
	IPR Notes	CNM	Y	Y	Y
Feature	**Descriptive Group**	ITN	Y	Y	Y
	Descriptive Term	ITN	Y	N	N
	Theme	CNM	Y	Y	Y
	Access Type	CNM	Y	Y	Y
	Feature Information	CNM	Y	Y	Y
Identity	**Toid**	ITN	Y	Y	Y
Geometry	**Bounded by**	ITN	Y	Y	Y

Table 9-3 Attributes of CNM composite features

9.5. Routing Feature Types referencing Geometry

Group	Attribute	Model	Node Information	Link Information	Partial Link Information	Route Information	Partial Route Information	Lane Information
Life Cycle	**Version**	ITN	Y	Y	Y	Y	Y	Y
	Version Date	ITN	Y	Y	Y	Y	Y	Y
	Change Date	ITN	Y	Y	Y	Y	Y	Y
	Reason for Change	ITN	Y	Y	Y	Y	Y	Y
	Changed By	ITN	Y	Y	Y	Y	Y	Y
Community Rights	**Contributor**	CNM	Y	Y	Y	Y	Y	Y
	Allowed Use	CNM	Y	Y	Y	Y	Y	Y
	Verification Status	CNM	Y	Y	Y	Y	Y	Y
	Survey Method	CNM	Y	Y	Y	Y	Y	Y
	IPR Notes	CNM	Y	Y	Y	Y	Y	Y
Feature	**Descriptive Group**	ITN	Y	Y	Y	Y	Y	Y
	Theme	ITN	Y	Y	Y	Y	Y	Y
	Access Type	ITN	Y	Y	Y	Y	Y	Y
	Feature Information	CNM	Y	Y	Y	Y	Y	Y
Identity	**Toid**	ITN	Y	Y	Y	Y	Y	Y
Subsection	**Point**	ITN	--	Y	--	Y	--	
Geometry	**Distance from start**	ITN	--	Y	--	Y	--	--
	Distance from start	ITN	--	Y	--	Y	--	--
	Subsection Distance	ITN	--	--	Y	Y	Y	--
	Subsection Point	ITN	--	--	Y	--	Y	--
	Reference To Node	ITN	Y	N	N	N	N	N
	Reference To Link	ITN	N	Y	Y	Y	Y	N
	Orientation	ITN	--	Y-	Y	--	-	--
	Directional	ITN	--	--	--	Y	Y	--
Qualifier	**Environmental Qualifier**	ITN	Y	Y	Y	Y	Y	--
	Vehicle Qualifier	ITN	Y	Y	Y	Y	Y	Y
	Date Time Qualifier	ITN	Y	Y	Y	Y	Y	Y
	Path Advisory Qualifier	CNM	Y	Y	Y	Y	Y	Y
	Lane Qualifier	CNM	--	-	-	-	-	Y

Table 9-4 Attributes of CNM Routing Features

9.6. Base Data Types

Table 9-5 shows low level data types used in the CNM specification.

Group	**Type**	**Based on**	**Note**
Basic	*boolean*	Xsd,boolean	
	string	Xsd.string	
	integer	Xsd.integer	
	nlstring	xsd.string + xsd.lang	String in a named language
	nmtoken	Xsd.NMTOKEN	Limited character string without spaces
Internet	*email*	W3C	Valid email
	url	Xsd.uri	Valid URI
Date & Time	*date*	Xsd.date	UTC
	dateTime	Xsd.dateTime	UTC
	time	Xsd.time	UTC
	duration	Xsd.duration	
Geometry	*point*	Gml/itn	
	polyline	Gml/itn	Ordered Collection of points
	extent	Gml/itn	Bounding box
	altitude	Gml/itn	
	profile	Gml/itn	Collection of altitudes
Distance related	*distance*	Gml/itn	Distance in specified units, e.g. miles, km
	metres	Gml/itn	Distance in metres
	velocity	Gml/itn	Velocity in specified units, e.g. m.p.h. or k.p.h.
	gradient	Gml/itn	Gradient in specified units

Table 9-5 Low level Data types used in the CNM

10. GENERAL DATA CAPTURE RULES

This section describes data capture rules for populating a CNM data set in addition to those for individual data types specified in section 9.

10.1. Roads

Cyclable thorough fares that are also accessible to motor vehicles should be captured as ITN roads and be given cycle attributes if necessary. If the Road is not publicly accessible this should be indicated as part of the ITN data

10.2. Paths

Paths are eligible for capture in the CNM data set as PATH LINKs if the following conditions are met:

- Provided a route cannot be inferred from the road network, i.e. they are not footway or pavement except for paths running parallel with Motorways or other roads with which they have no interaction. For example, if access is physically prevented between the path and the road along the entire length of the ROAD LINK.
- CNM differs from ITN PN in that in some cases PATH LINKs may be created for unsegregated sections of road. PATH LINKs may be created if the cycle route involves use of pavement and if defining an explicit path allows an exact topology and separate GEOMETRY and attribution to be provided.
- If the Path is not publicly accessible, the ACCESS TYPE should be indicated

Even where ITN PN data exists it should not be assumed that the network is complete. CNM supports the ability to include Pedestrian Network features from different sources.

10.3. Connecting Links/Nodes

CONNECTING FEATURES provide connectivity between elements of the network. They:

- Connect the path network to the road network.
- Indicate the connectivity between elements of the road network where no path exists. For example, if it is deemed too short to be included as a Path Network. A common use is to indicate that pedestrian access is possible through a closed/broken road.
- Indicate connectivity between elements of the path network, for example can be used to represent path network elements connected by staircases, lifts etc.

CONNECTING LINKs have several characteristics

- GEOMETRY of CONNECTING LINK is not a reflection of the precise location of any route. It is just the shortest geometric link between the features to be collected.
- CONNECTING LINKs have no intermediate vertexes.
- CONNECTING LINKs should not join other CONNECTING LINK features.
- CONNECTING LINKs should be no greater than 20 metres.

- CNM attribution can be applied to CONNECTING LINKs, if not present then pedestrian access for walking and cycling is assumed.

10.4. Access Links/Nodes

ACCESS FEATUREs indicate access from a cycle, path or road network to a FUNCTIONAL SITE.

- An ITN ACCESS LINK's GEOMETRY does not reflect the precise location of any route
- CNM attribution can be applied to ITN ACCESS LINKs; if not present then pedestrian access for walking and cycling is assumed.

An ACCESS NODE may be further associated with a PLACE REFERENCE to tie it in with other transport network layers other than ITN., for example, NaPTAN.

10.5. Lanes

LANE INFORMATION should only be associated with ROUTING INFORMATION when the properties of the ROUTING INFORMATION, defined through QUALIFIERS, only apply to a selection of the lanes of the associated link. If the ROUTING INFORMATION applies to all the lanes of a link LANE INFORMATION does not need to be defined.

LANE QUALIFIERs are applied to links using ROUTING INFORMATION features. These LANE QUALIFIERS apply to one or more of the lanes depending presence and properties of the LANE INFORMATION feature.

10.6. Manoeuvres

MANOEUVREs should be defined as ROUTING INFORMATION between the start and end RMANOEUVRABILITY LINKs, or PATH LINKs, using a PATH ADVISORY QUALIFIER / CYCLING MANOEUVRABILITY / MANOEUVRABILITY to indicate the suitability.

- Where there are additional complex transits possible through a junction.
- Where certain transits are recommended, dangerous or prohibited.
- Where additional instructions may be helpful for understanding how to use of a junction in a particular transit.

A LANE INFORMATION can also be used to indicate transit from and to lanes of the ROAD LINKS or PATH LINKS.

10.7. Subjective Attributes

The CNM includes several subjective attributes:

- PATH ADVISORY QUALIFIER / RECOMMENDATIONS.
- PATH ADVISORY QUALIFIER / QUIETNESS, EFFORT, CONGESTION.
- PATH ADVISORY QUALIFIER / LIGHTING, PERSONAL SAFETY.
- PATH ADVISORY QUALIFIER / MANOEUVRABILITY / RATING.

These (and other) attributes are defined in section 9, and should be captured as per the definition provided using on ground surveys local cyclists and local authority knowledge, as required.

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11. XML SCHEMA

The CycleNetXChange XML schema provides a concrete implementation of the CNM model for exchanging data.
It is built as an extension to the ITN OS schemas [ITN1], which in turn extend the GML schemas. The CNM extensions include

- Cycle network elements
- Cycle network attributes
- Community data management attributes

The schema allows arbitrary lists of Cycle network elements to be exchanged, as well as contributor data. It can also be used to exchange ITN Road and Path network data.

The schema can be found at http://www.cyclenetxchange.org.uk. CNM elements are assigned to a separate namespace.

12. XML EXAMPLES

This section provides examples of different CNM features encoded as XML.

Note: the examples data values are illustrative only and are not intended to be rigorously consistent or correct. In particular, the values shown for coordinate data are bogus.

12.1. Contributor Organisation – XML Example

The following XML code fragment shows an *ContributorOrganisation* with prefix 'abcd' reserved for= its data.

```
<cnm:contributorMember>
	<cnm:ContributorOrganisation gml:id="abcd_org_02">
		<gml:description>Cycle data cooperative</gml:description>
		<gml:name>CX01</gml:name>
		<cnm:ChangeHistory>
			<cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
			<cnm:reasonForChange>New</cnm:reasonForChange>
			<cnm:changedBy xlink:href="#abcd_ind_01"/>
			<cnm:role>Supply</cnm:role>
		</cnm:ChangeHistory>
		<cnm:contributorType>Community Member</cnm:contributorType>
		<cnm:email>'org@cyclops.co.uk'</cnm:email>
		<cnm:allowPublishEmail>true</cnm:allowPublishEmail>
		<cnm:webSite>http://www.cyclops.co.uk</cnm:webSite>
		<cnm:note xml:lang="en">All for fun</cnm:note>
		<cnm:dnfPrefix>abcd</cnm:dnfPrefix>
	</cnm:ContributorOrganisation>
</cnm:contributorMember>
```

12.2. Individual Contributor – XML Example

The following XML code fragment shows an ***IndividualContributor*** with id 'abcd_ind_01'.

```
<cnm:contributorMember>
	<cnm:IndividualContributor gml:id="abcd_ind_01" cnm:referenceLayer="String"
cnm:version="0">
		<cnm:ChangeHistory>
			<cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
			<cnm:reasonForChange>New</cnm:reasonForChange>
			<cnm:changedBy xlink:href="#abcd_ind_01"/>
			<cnm:role>Supply</cnm:role>
		</cnm:ChangeHistory>
		<cnm:contributorType>Community Member</cnm:contributorType>
		<cnm:email>'al@cyclopath.com'</cnm:email>
		<cnm:allowPublishEmail>true</cnm:allowPublishEmail>
		<cnm:webSite>http://www.cyclopath.com</cnm:webSite>
		<cnm:contributorName xml:lang="en">Al Truism</cnm:contributorName>
		<cnm:contributorOrganisation xlink:href="#abcd_org_02"/>
	</cnm:IndividualContributor>
</cnm:contributorMember>
```

12.3. Aggregated Way – XML Example

The following XML code fragment shows an ***AggregatedWay*** with a number of member elements.

```
<cnm:networkMember>
	<cnm:AggregatedWay fid="abcd_agWay_01">
		<osgb:version>22</osgb:version>
		<osgb:versionDate>2007-08-13</osgb:versionDate>
		<osgb:theme>Path Network</osgb:theme>
		<cnm:ChangeHistory>
			<cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
```

```
                        <cnm:reasonForChange>Attributes</cnm:reasonForChange>
                        <cnm:changedBy xlink:href="#abcd_ind_01"/>
                        <cnm:role>Supply</cnm:role>
                </cnm:ChangeHistory>
                <cnm:CommunityRights>
                        <cnm:contributorMember xlink:href="#abcd_ind_01"/>
                        <cnm:surveyMethod>Ground Survey</cnm:surveyMethod>
                        <cnm:status>Unverified</cnm:status>
                        <cnm:allowedUse>Open Licence</cnm:allowedUse>
                </cnm:CommunityRights>
                <cnm:descriptiveGroup>Named Path</cnm:descriptiveGroup>
                <cnm:descriptiveTerm>Track</cnm:descriptiveTerm>
                <cnm:name xml:lang="en">Watling street</cnm:name>
                <cnm:networkMember xlink:href="#abcd_rNode_01"/>
                <cnm:networkMember xlink:href="#abcd_rNode_02"/>
                <cnm:networkMember xlink:href="#abcd_rLink_01_02"/>
                <cnm:networkMember xlink:href="#abcd_pLink_02_03"/>
                <cnm:networkMember xlink:href="#abcd_pNode_02"/>
                <cnm:networkMember xlink:href="#abcd_pNode_03"/>
                <cnm:boundedBy>
                        <gml:Box srsName="osgb:BNG">
                                <gml:coordinates>462905.000,99261.000
540212.000,180646.000</gml:coordinates>
                        </gml:Box>
                </cnm:boundedBy>
        </cnm:AggregatedWay>
</cnm:networkMember>
```

12.4. Cycle Information – XML Example

The following XML code fragment shows a ***CycleInformation.***

```
<cnm:pathInformationMember>
        <cnm:CycleInformation fid="abcd_cycInfo_01">
                <osgb:version>22</osgb:version>
                <osgb:versionDate>2007-08-13</osgb:versionDate>
                <osgb:theme>Path Network</osgb:theme>
                <cnm:ChangeHistory>
                        <cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
                        <cnm:reasonForChange>Attributes</cnm:reasonForChange>
                        <cnm:changedBy xlink:href="#abcd_ind_01"/>
                        <cnm:role>Supply</cnm:role>
                </cnm:ChangeHistory>
                <cnm:CommunityRights>
                        <cnm:contributorMember xlink:href="#abcd_ind_01"/>
                        <cnm:surveyMethod>Unknown</cnm:surveyMethod>
                        <cnm:status>Unverified</cnm:status>
                        <cnm:allowedUse>Open Licence</cnm:allowedUse>
                </cnm:CommunityRights>
                <cnm:descriptiveGroup>Path</cnm:descriptiveGroup>
                <cnm:routeName xml:lang="en">Super Path</cnm:routeName>
                <cnm:routeCode>B32</cnm:routeCode>
                <cnm:referenceToAggregatedWay xlink:href="#abcd_agWay_01"/>
                <cnm:cycleRouteType>National</cnm:cycleRouteType>
        </cnm:CycleInformation>
</cnm:pathInformationMember>
```

12.5. Path Node – XML Example

The following XML code fragment shows a ***PathNode.***

```
<cnm:networkMember>
        <cnm:PathNode fid="abcd_pNode_01">
                <osgb:version>1</osgb:version>
                <osgb:versionDate>2007-08-13</osgb:versionDate>
                <osgb:theme>Path Network</osgb:theme>
                <cnm:ChangeHistory>
                        <cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
                        <cnm:reasonForChange>New</cnm:reasonForChange>
                        <cnm:changedBy xlink:href="#abcd_ind_01"/>
                        <cnm:role>Supply</cnm:role>
```

```
                </cnm:ChangeHistory>
                <cnm:CommunityRights>
                        <cnm:contributorMember xlink:href="#abcd_ind_01"/>
                        <cnm:surveyMethod>Manual Desktop</cnm:surveyMethod>
                        <cnm:status>Community Verified</cnm:status>
                        <cnm:allowedUse>Open Licence</cnm:allowedUse>
                </cnm:CommunityRights>
                <cnm:access>Public</cnm:access>
                <cnm:descriptiveGroup>Path Topology</cnm:descriptiveGroup>
                <cnm:descriptiveTerm>Path</cnm:descriptiveTerm>
                <cnm:point>
                        <gml:Point srsName="osgb:BNG">
                                <gml:coordinates>533848.110,179656.227</gml:coordinates>
                        </gml:Point>
                </cnm:point>
                <cnm:referenceToTopographicArea xlink:href="#osgb1000001769288909"/>
        </cnm:PathNode>
</cnm:networkMember>
```

12.6. Path Link – XML Example

The following XML code fragment shows a ***PathLink.***

```
<cnm:networkMember>
        <cnm:PathLink fid="abcd_pLink_01_02">
                <gml:description>String</gml:description>
                <osgb:version>99</osgb:version>
                <osgb:versionDate>2004-07-27</osgb:versionDate>
                <osgb:theme>Road Network</osgb:theme>
                <osgb:theme>Path Topology</osgb:theme>
                <cnm:ChangeHistory>
                        <cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
                        <cnm:reasonForChange>Attributes</cnm:reasonForChange>
                        <cnm:changedBy xlink:href="#abcd_ind_01"/>
                        <cnm:role>Supply</cnm:role>
                </cnm:ChangeHistory>
                <cnm:CommunityRights>
                        <cnm:contributorMember xlink:href="#abcd_ind_01"/>
                        <cnm:surveyMethod>Ground Survey</cnm:surveyMethod>
                        <cnm:status>Professionally Verified</cnm:status>
                        <cnm:allowedUse>Open Licence</cnm:allowedUse>
                </cnm:CommunityRights>
                <cnm:access>Public</cnm:access>
                <cnm:descriptiveGroup>Path Topology</cnm:descriptiveGroup>
                <cnm:descriptiveTerm>Bridlepath</cnm:descriptiveTerm>
                <cnm:make>Manmade</cnm:make>
                <cnm:length
uom="http://www.ordnancesurvey.co.uk/xml/resource/units.xml#metres">356.028</cnm:length>
                <cnm:polyline>
                        <gml:LineString srsName="osgb:BNG">
                                <gml:coordinates>539167.000,170872.000 539183.000,170854.000
539211.422,170823.413 539235.273,170797.560 539287.189,170741.305 539330.000,170695.000
539385.000,170643.000 539388.822,170639.719 539411.000,170620.000
539414.000,170616.000</gml:coordinates>
                        </gml:LineString>
                </cnm:polyline>
                <cnm:directedNode gradeSeparation="0" orientation="-" xlink:href="#abcd_pNode_01">
                        </cnm:directedNode>
                <cnm:directedNode gradeSeparation="0" orientation="+" xlink:href="#abcd_pNode_02">
                        </cnm:directedNode>
                <cnm:gradeSeparation>0</cnm:gradeSeparation>
                <cnm:legalRights>Byway Open To All Traffic</cnm:legalRights>
                <cnm:referenceToTopographicArea xlink:href="#abcd_topref01"/>
                <cnm:referenceToTopographicArea xlink:href="#osgb1000001768732822"/>
                <cnm:referenceToTopographicArea xlink:href="#osgb1000001768733362"/>
                <cnm:referenceToTopographicArea xlink:href="#osgb1000001768733586"/>
        </cnm:PathLink>
</cnm:networkMember>
```

12.7. Path Node Information– XML Example

The following XML code fragment shows a ***PathNodeInformation.***

```
<cnm:pathInformationMember>
	<cnm:PathNodeInformation fid="abcd_pNodeIndo_02a">
		<osgb:version>55</osgb:version>
		<osgb:versionDate>2007-08-13</osgb:versionDate>
		<osgb:theme>Path Network</osgb:theme>
		<cnm:ChangeHistory>
			<cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
			<cnm:reasonForChange>Attributes</cnm:reasonForChange>
			<cnm:changedBy xlink:href="#abcd_ind_01"/>
			<cnm:role>Supply</cnm:role>
		</cnm:ChangeHistory>
		<cnm:CommunityRights>
			<cnm:contributorMember xlink:href="#abcd_ind_01"/>
			<cnm:surveyMethod>Unknown</cnm:surveyMethod>
			<cnm:status>Unverified</cnm:status>
			<cnm:allowedUse>Open Licence</cnm:allowedUse>
		</cnm:CommunityRights>
		<cnm:descriptiveGroup>Path Routing Information</cnm:descriptiveGroup>
		<cnm:descriptiveTerm>Footbridge</cnm:descriptiveTerm>
		<cnm:referenceToNode xlink:href="#abcd_pNode_02"/>
		<cnm:DateTimeQualifier>
			<osgb:namedPeriod>String</osgb:namedPeriod>
			<cnm:temporalSpan>
				<cnm:dayType>Monday</cnm:dayType>
				<cnm:periodType>Spring</cnm:periodType>
				<cnm:otherDayType>Market Days</cnm:otherDayType>
				<cnm:namedTimeType>Dawn till Dusk</cnm:namedTimeType>
			</cnm:temporalSpan>
		</cnm:DateTimeQualifier>
		<cnm:PathAdvisoryQualifier>
			<cnm:recommendation>For Schools</cnm:recommendation>
			<cnm:CyclingManoeuvrability>
				<cnm:manoeuvrability>Advanced</cnm:manoeuvrability>
				<cnm:instruction>Alight</cnm:instruction>
			</cnm:CyclingManoeuvrability>
			<cnm:quietness>Very Busy</cnm:quietness>
			<cnm:congestion>Free Flowing</cnm:congestion>
			<cnm:lighting>None</cnm:lighting>
		</cnm:PathAdvisoryQualifier>
	</cnm:PathNodeInformation>
</cnm:pathInformationMember>
```

12.8. Path Link Information – XML Example

The following XML code fragment shows a ***PathLinkInformation,*** used to encode a bus lane.

```
<cnm:pathInformationMember>
	<cnm:PathLinkInformation fid="abcd_pLinkInfo_01_02_a">
		<gml:name>bus lane</gml:name>
		<osgb:version>22</osgb:version>
		<osgb:versionDate>2007-08-13</osgb:versionDate>
		<osgb:theme>Path Network</osgb:theme>
		<cnm:ChangeHistory>
			<cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
			<cnm:reasonForChange>Attributes</cnm:reasonForChange>
			<cnm:changedBy xlink:href="#abcd_ind_01"/>
			<cnm:role>Supply</cnm:role>
		</cnm:ChangeHistory>
		<cnm:CommunityRights>
			<cnm:contributorMember xlink:href="#abcd_ind_01"/>
			<cnm:surveyMethod>Unknown</cnm:surveyMethod>
			<cnm:status>Unverified</cnm:status>
			<cnm:allowedUse>Open Licence</cnm:allowedUse>
		</cnm:CommunityRights>
		<cnm:descriptiveGroup>Path Routing Information</cnm:descriptiveGroup>
		<cnm:referenceToLink xlink:href="#abcd_pLink_01_02"/>
		<cnm:orientation>+</cnm:orientation>

		<cnm:DateTimeQualifier>
```

```
                        <osgb:specifiedPeriod>
                                <osgb:namedDate>String</osgb:namedDate>
                                <osgb:day>Weekdays</osgb:day>
                                <osgb:specifiedTime>
                                        <osgb:startTime>07:00:00Z</osgb:startTime>
                                        <osgb:endTime>19:00:00Z</osgb:endTime>
                                </osgb:specifiedTime>
                        </osgb:specifiedPeriod>
                        <cnm:temporalSpan>
                                <cnm:dayType>Weekdays</cnm:dayType>
                        </cnm:temporalSpan>
                </cnm:DateTimeQualifier>
                <cnm:DateTimeQualifier>
                        <osgb:specifiedPeriod>
                                <osgb:day>Saturday</osgb:day>
                                <osgb:specifiedTime>
                                        <osgb:startTime>07:00:00Z</osgb:startTime>
                                        <osgb:endTime>12:00:00Z</osgb:endTime>
                                </osgb:specifiedTime>
                        </osgb:specifiedPeriod>
                        <cnm:temporalSpan>
                                <cnm:dayType>Saturday</cnm:dayType>
                        </cnm:temporalSpan>
                </cnm:DateTimeQualifier>
                <cnm:VehicleQualifier>
                        <osgb:type exceptFor="false">Bus</osgb:type>
                        <osgb:use exceptFor="true">String</osgb:use>
                </cnm:VehicleQualifier>
                <cnm:LaneQualifier>
                        <cnm:averageWidth
uom="http://www.ordnancesurvey.co.uk/xml/resource/units.xml#metres">12</cnm:averageWidth>
                        <cnm:surface>tarmac</cnm:surface>
                        <cnm:cyclingProvision>Bus Lane</cnm:cyclingProvision>
                        <cnm:cycleUse>Shared Use</cnm:cycleUse>
                </cnm:LaneQualifier>
                <cnm:PathAdvisoryQualifier>
                        <cnm:recommendation>For Schools</cnm:recommendation>
                        <cnm:quietness>Busy</cnm:quietness>
                        <cnm:congestion>Congested</cnm:congestion>
                        <cnm:effort>Moderate</cnm:effort>
                        <cnm:lighting>Present</cnm:lighting>
                        <cnm:PersonalSafety>
                                <cnm:safetyReputation>Normally Safe Area</cnm:safetyReputation>
                        </cnm:PersonalSafety>
                </cnm:PathAdvisoryQualifier>
        </cnm:PathLinkInformation>
</cnm:pathInformationMember>
```

12.9. Road Node – XML Example

The following XML code fragment shows a ***RoadNode.***

```
<cnm:networkMember>
        <cnm:Road fid="abcd_road_01">
                <gml:description>The A212 road</gml:description>
                <osgb:version>04</osgb:version>
                <osgb:versionDate>2007-08-13</osgb:versionDate>
                <osgb:theme>Road Network</osgb:theme>
                <cnm:ChangeHistory>
                        <cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
                        <cnm:reasonForChange>New</cnm:reasonForChange>
                        <cnm:changedBy xlink:href="#abcd_ind_01"/>
                        <cnm:role>Supply</cnm:role>
                </cnm:ChangeHistory>
                <cnm:CommunityRights>
                        <cnm:contributorMember xlink:href="#abcd_ind_01"/>
                        <cnm:surveyMethod>Manual Desktop</cnm:surveyMethod>
                        <cnm:status>Community Verified</cnm:status>
                        <cnm:allowedUse>Open Licence</cnm:allowedUse>
                </cnm:CommunityRights>
                <cnm:access>Public</cnm:access>
                <cnm:descriptiveGroup>Named Road</cnm:descriptiveGroup>
                <cnm:descriptiveTerm>Trunk Road</cnm:descriptiveTerm>
```

```
                <cnm:roadName xml:lang="en">A 212</cnm:roadName>
                <cnm:networkMember xlink:href="#abcd_rNode_01"/>
                <cnm:networkMember xlink:href="#abcd_rNode_02"/>
                <cnm:networkMember xlink:href="#abcd_rNode_03"/>
                <cnm:networkMember xlink:href="#abcd_rLink_01_02"/>
                <cnm:networkMember xlink:href="#abcd_rLink_02_03"/>
                <cnm:boundedBy>
                        <gml:null>unknown</gml:null>
                </cnm:boundedBy>
        </cnm:Road>
</cnm:networkMember>
```

12.10. Road Link – XML Example

The following XML code fragment shows a ***RoadLink.***

```
<cnm:networkMember>
        <cnm:RoadLink fid="abcd_rLink_01_02">
                <osgb:version>99</osgb:version>
                <osgb:versionDate>2004-07-27</osgb:versionDate>
                <osgb:theme>Road Network</osgb:theme>
                <cnm:ChangeHistory>
                        <cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
                        <cnm:reasonForChange>Attributes</cnm:reasonForChange>
                        <cnm:changedBy xlink:href="#abcd_ind_01"/>
                        <cnm:role>Supply</cnm:role>
                </cnm:ChangeHistory>
                <cnm:CommunityRights>
                        <cnm:contributorMember xlink:href="#abcd_ind_01"/>
                        <cnm:surveyMethod>Ground Survey</cnm:surveyMethod>
                        <cnm:status>Professionally Verified</cnm:status>
                        <cnm:allowedUse>Open Licence</cnm:allowedUse>
                </cnm:CommunityRights>
                <cnm:access>Public</cnm:access>
                <cnm:descriptiveGroup>Road Topology</cnm:descriptiveGroup>
                <cnm:descriptiveTerm>B Road</cnm:descriptiveTerm>
                <cnm:natureOfRoad>Single Carriageway</cnm:natureOfRoad>
                <cnm:length>1000</cnm:length>
                <cnm:polyline>
                        <gml:LineString srsName="osgb:BNG">
                                <gml:coordinates>539167.000,170872.000 539183.000,170854.000
539211.422,170823.413 539235.273,170797.560 539287.189,170741.305 539330.000,170695.000
539385.000,170643.000 539388.822,170639.719 539411.000,170620.000
539414.000,170616.000</gml:coordinates>
                        </gml:LineString>
                </cnm:polyline>
                <cnm:directedNode gradeSeparation="0" orientation="-" xlink:href="#abcd_rNode_01">
                                </cnm:directedNode>
                <cnm:directedNode gradeSeparation="0" orientation="+" xlink:href="#abcd_rNode_02">
                                </cnm:directedNode>
                <cnm:referenceToTopographicArea xlink:href="#abcd_topref01"/>
                <cnm:referenceToTopographicArea xlink:href="#osgb1000001768732822"/>
        </cnm:RoadLink>
</cnm:networkMember>
```

12.11. Road Partial Link Information Example – XML Example

The following XML code fragment shows a ***RoadPartialLinkInformation*** applying between two points***.*** It shows a use to apply CNM attributes to an ITN ***RoadLink*** between two points***.*** It is further qualified by a ***LaneInformation*** that restricts the scope to a lane.

```
<cnm:roadInformationMember>
        <cnm:RoadPartialLinkInformation fid="abcd_partRLinkInfo_01">
                <osgb:version>22</osgb:version>
                <osgb:versionDate>2007-08-13</osgb:versionDate>
                <osgb:theme>Road Network</osgb:theme>
                <cnm:ChangeHistory>
                        <cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
                        <cnm:reasonForChange>New</cnm:reasonForChange>
```

```
                        <cnm:changedBy xlink:href="#abcd_ind_01"/>
                        <cnm:role>Supply</cnm:role>
                </cnm:ChangeHistory>
                <cnm:CommunityRights>
                        <cnm:contributorMember xlink:href="#abcd_ind_01"/>
                        <cnm:surveyMethod>Manual Desktop</cnm:surveyMethod>
                        <cnm:status>Community Verified</cnm:status>
                        <cnm:allowedUse>Open Licence</cnm:allowedUse>
                </cnm:CommunityRights>
                <cnm:descriptiveGroup>Road Routing Information</cnm:descriptiveGroup>
                <cnm:LaneInformation>
                        <cnm:LaneNumber>1</cnm:LaneNumber>
                        <cnm:DirectionOfUse>Positive Only</cnm:DirectionOfUse>
                </cnm:LaneInformation>
                <cnm:referenceToRoadLink xlink:href="#abcd_rLink_01_02"/>
                <cnm:subsectionDistance>200</cnm:subsectionDistance>
                <cnm:subsectionPoint>
                        <gml:Point srsName="osgb:BNG">
                                <gml:coordinates>533848.110,179656.227</gml:coordinates>
                        </gml:Point>
                </cnm:subsectionPoint>
                <cnm:subsectionDistance>600</cnm:subsectionDistance>
                <cnm:subsectionPoint>
                        <gml:Point srsName="osgb:BNG">
                                <gml:coordinates>533849.110,179657.227</gml:coordinates>
                        </gml:Point>
                </cnm:subsectionPoint>
                        <osgb:type exceptFor="true">Local Bus</osgb:type>
                </cnm:VehicleQualifier>
                <cnm:EnvironmentQualifier>
                        <osgb:instruction>Access Limited To</osgb:instruction>
                        <osgb:classification>String</osgb:classification>
                        <osgb:classification>String</osgb:classification>
                </cnm:EnvironmentQualifier>
                <cnm:EnvironmentQualifier>
                        <osgb:instruction>Access Limited To</osgb:instruction>
                        <osgb:classification>String</osgb:classification>
                        <osgb:classification>String</osgb:classification>
                </cnm:EnvironmentQualifier>
                <cnm:LaneQualifier>
                        <cnm:AverageWidth>12</cnm:averageWidth>
                        <cnm:surface>tarmac</cnm:surface>
                        <cnm:cyclingProvision>Bus Lane</cnm:cyclingProvision>
                        <cnm:cycleUse>Shared Use</cnm:cycleUse>
                </cnm:LaneQualifier>
        </cnm:RoadPartialLinkInformation>
</cnm:roadInformationMember>
```

12.12. Connecting Node – XML Example

The following XML code fragment shows a ***ConnectingNode.*** That references a ***RoadNode.***

```
<cnm:networkMember>
        <cnm:ConnectingNode fid="abcd_cNode_r02">
                <osgb:version>1</osgb:version>
                <osgb:versionDate>2007-08-13</osgb:versionDate>
                <osgb:theme>Path Network</osgb:theme>
                <cnm:ChangeHistory>
                        <cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
                        <cnm:reasonForChange>New</cnm:reasonForChange>
                        <cnm:changedBy xlink:href="#abcd_ind_01"/>
                        <cnm:role>Supply</cnm:role>
                </cnm:ChangeHistory>
                <cnm:CommunityRights>
                        <cnm:contributorMember xlink:href="#abcd_ind_01"/>
                        <cnm:surveyMethod>Manual Desktop</cnm:surveyMethod>
                        <cnm:status>Community Verified</cnm:status>
                        <cnm:allowedUse>Open Licence</cnm:allowedUse>
                </cnm:CommunityRights>
                <cnm:access>Public</cnm:access>
                <cnm:descriptiveGroup>Path Topology</cnm:descriptiveGroup>
```

```
                <cnm:networkLocation>
                        <cnm:referenceToNode xlink:href="abcd_rNode_02"/>
                </cnm:networkLocation>
                <cnm:point>
                        <gml:Point srsName="osgb:BNG">
                                <gml:coordinates>533848.110,179656.227</gml:coordinates>
                        </gml:Point>
                </cnm:point>
                <cnm:referenceToTopographicArea xlink:href="#osgb1000001769288909"/>
        </cnm:ConnectingNode>
</cnm:networkMember>
```

The following XML code fragment shows a ***ConnectingNode.*** That references a ***PathNode.***

```
<cnm:networkMember>
        <cnm:ConnectingNode fid="abcd_cNode_p02">
                <osgb:version>22</osgb:version>
                <osgb:versionDate>2007-08-13</osgb:versionDate>
                <osgb:theme>Path Network</osgb:theme>
                <cnm:ChangeHistory>
                        <cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
                        <cnm:reasonForChange>Attributes</cnm:reasonForChange>
                        <cnm:changedBy xlink:href="#abcd_ind_01"/>
                        <cnm:role>Supply</cnm:role>
                </cnm:ChangeHistory>
                <cnm:CommunityRights>
                        <cnm:contributorMember xlink:href="#abcd_ind_01"/>
                        <cnm:surveyMethod>Manual Desktop</cnm:surveyMethod>
                        <cnm:status>Community Verified</cnm:status>
                        <cnm:allowedUse>Open Licence</cnm:allowedUse>
                </cnm:CommunityRights>
                <cnm:access>Public</cnm:access>
                <cnm:descriptiveGroup>Path Topology</cnm:descriptiveGroup>
                <cnm:networkLocation>
                        <cnm:referenceToNode xlink:href="abcd_pNode_02"/>
                </cnm:networkLocation>
                <cnm:point>
                        <gml:Point srsName="osgb:BNG">
                                <gml:coordinates>533908.000,179684.000</gml:coordinates>
                        </gml:Point>
                </cnm:point>
                <cnm:referenceToTopographicArea xlink:href="#osgb1000001769288909"/>
        </cnm:ConnectingNode>
</cnm:networkMember>
```

12.13. Connecting Link – XML Example

The following XML code fragment shows a ***PathLink*** connecting the two ***ConnectingNode*** instance shown above and indicating the link between the Path and the Road Network.

```
<cnm:networkMember>
        <cnm:ConnectingLink fid="abcd_cLink_02_02">
                <osgb:version>99</osgb:version>
                <osgb:versionDate>2004-07-27</osgb:versionDate>
                <osgb:theme>Road Network</osgb:theme>
                <osgb:theme>Address</osgb:theme>
                <cnm:ChangeHistory>
                        <cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
                        <cnm:reasonForChange>Attributes</cnm:reasonForChange>
                        <cnm:changedBy xlink:href="#abcd_ind_01"/>
                        <cnm:role>Supply</cnm:role>
                </cnm:ChangeHistory>
                <cnm:CommunityRights>
                        <cnm:contributorMember xlink:href="#abcd_ind_01"/>
                        <cnm:surveyMethod>Ground Survey</cnm:surveyMethod>
                        <cnm:status>Professionally Verified</cnm:status>
                        <cnm:allowedUse>Open Licence</cnm:allowedUse>
                </cnm:CommunityRights>
                <cnm:access>Public</cnm:access>
                <cnm:descriptiveGroup>Path Topology</cnm:descriptiveGroup>
                <cnm:length>100</cnm:length>
                <cnm:polyline>
                        <gml:LineString srsName="osgb:BNG">
```

```
                        <gml:coordinates>539167.000,170872.000 539183.000,170854.000
539211.422,170823.413 539235.273,170797.560 539287.189,170741.305 539330.000,170695.000
539385.000,170643.000 539388.822,170639.719 539411.000,170620.000
539414.000,170616.000</gml:coordinates>
                </gml:LineString>
        </cnm:polyline>
        <cnm:directedNode gradeSeparation="0" orientation="-" xlink:href="#abcd_rNode_02">
                </cnm:directedNode>
        <cnm:directedNode gradeSeparation="0" orientation="+" xlink:href="#abcd_pNode_02">
                </cnm:directedNode>
    </cnm:ConnectingLink>
</cnm:networkMember>
```

12.14. Access Node – XML Example

The following XML code fragment shows an ***AccessNode*** representing a designated entrance to a ***FunctionalSite***.

```
<cnm:networkMember>
    <cnm:AccessNode fid="abcd_aNode_01">
        <gml:name>Door to Cycle shop</gml:name>
        <osgb:version>2</osgb:version>
        <osgb:versionDate>2007-08-13</osgb:versionDate>
        <osgb:theme>Path Network</osgb:theme>
        <cnm:ChangeHistory>
            <cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
            <cnm:reasonForChange>Attributes</cnm:reasonForChange>
            <cnm:changedBy xlink:href="#abcd_ind_01"/>
            <cnm:role>Supply</cnm:role>
        </cnm:ChangeHistory>
        <cnm:CommunityRights>
            <cnm:contributorMember xlink:href="#abcd_ind_01"/>
            <cnm:surveyMethod>Unknown</cnm:surveyMethod>
            <cnm:status>Unverified</cnm:status>
            <cnm:allowedUse>Open Licence</cnm:allowedUse>
        </cnm:CommunityRights>
        <cnm:descriptiveGroup>Path Topology</cnm:descriptiveGroup>
        <cnm:descriptiveTerm>Door</cnm:descriptiveTerm>
        <cnm:point>
            <gml:Point srsName="osgb:BNG">
                <gml:coordinates>533908.000,179684.000</gml:coordinates>
            </gml:Point>
        </cnm:point>
    </cnm:AccessNode>
</cnm:networkMember>
```

12.15. Access Link – XML Example

The following XML code fragment shows a ***AccessLink*** connecting a designated ***AccessNode*** entrance to a ***FunctionalSite***.

```
<cnm:networkMember>
    <cnm:AccessLink fid="abcd_aLink_01_02">
        <gml:description>Door to cycle shop</gml:description>
        <osgb:version>99</osgb:version>
        <osgb:versionDate>2004-07-27</osgb:versionDate>
        <osgb:theme>Road Network</osgb:theme>
        <osgb:theme>Address</osgb:theme>
        <cnm:ChangeHistory>
            <cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
            <cnm:reasonForChange>Attributes</cnm:reasonForChange>
            <cnm:changedBy xlink:href="#abcd_ind_01"/>
            <cnm:role>Supply</cnm:role>
        </cnm:ChangeHistory>
        <cnm:CommunityRights>
            <cnm:contributorMember xlink:href="#abcd_ind_01"/>
            <cnm:surveyMethod>Ground Survey</cnm:surveyMethod>
            <cnm:status>Professionally Verified</cnm:status>
            <cnm:allowedUse>Open Licence</cnm:allowedUse>
```

```
                </cnm:CommunityRights>
                <cnm:access>Public</cnm:access>
                <cnm:descriptiveGroup>Path Topology</cnm:descriptiveGroup>
                <cnm:referenceToFunctionalSite xlink:href="#abcd_cycFun_01"/>
                <cnm:referenceToAccessNode xlink:href="#abcd_aNode_01"/>
                <cnm:length>34</cnm:length>
                <cnm:polyline>
                        <gml:LineString srsName="osgb:BNG">
                                <gml:coordinates>539167.000,170872.000 539183.000,170854.000
539211.422,170823.413 539235.273,170797.560 539287.189,170741.305 539330.000,170695.000
539385.000,170643.000 539388.822,170639.719 539411.000,170620.000
539414.000,170616.000</gml:coordinates>
                        </gml:LineString>
                </cnm:polyline>
        </cnm:AccessLink>
</cnm:networkMember>
```

12.16. Cycle Functional Site– XML Example

The following XML code fragment shows a ***CycleFunctional Site*** with cycle parking.

```
<cnm:networkMember>
        <cnm:CycleFunctionalSite fid="abcd_cycFun_02">
                <gml:description>Cycle parking</gml:description>
                <osgb:version>0</osgb:version>
                <osgb:versionDate>2007-08-13</osgb:versionDate>
                <osgb:theme>Address</osgb:theme>
                <cnm:ChangeHistory>
                        <cnm:changeDate>2001-12-17T09:30:47.0Z</cnm:changeDate>
                        <cnm:reasonForChange>Attributes</cnm:reasonForChange>
                        <cnm:changedBy xlink:href="#abcd_ind_01"/>
                        <cnm:role>Supply</cnm:role>
                </cnm:ChangeHistory>
                <cnm:CommunityRights>
                        <cnm:contributorMember xlink:href="#abcd_ind_01"/>
                        <cnm:surveyMethod>Unknown</cnm:surveyMethod>
                        <cnm:status>Unverified</cnm:status>
                        <cnm:allowedUse>Open Licence</cnm:allowedUse>
                </cnm:CommunityRights>
                <cnm:descriptiveGroup>Functional Site</cnm:descriptiveGroup>
                <cnm:descriptiveTerm>Cycle Parking</cnm:descriptiveTerm>
                <cnm:referenceToAccess xlink:href="#abcd_acNode_01"/>
                <cnm:point>
                        <gml:Point srsName="osgb:BNG">
                                <gml:coordinates>533908.000,179684.000</gml:coordinates>
                        </gml:Point>
                </cnm:point>
                <cnm:cycleParking>hoop</cnm:cycleParking>
        </cnm:CycleFunctionalSite>
</cnm:networkMember>
```

13. ANNEX A - THE ITN RN & PN NETWORKS

This Annex summarises elements of the ITN Road Network & Path Network that are of relevance to the CNM.

13.1. Base ITN Road Network

The ITN Road Network describes the roads and junctions of the road network.

Road Network Introduction

The base ITN Road Network model is introduced in Figure 13-1, omitting some details on elements not relevant for CNM such as ferries. See OS ITN Guide [ITN1] Chapter 4 for further details.

Road Features:

- ROADs are made up of one or more ROAD LINKs, connected by ROAD NODEs at either end. To project onto a map; these NETWORK MEMBERs may be associated with TOPOGRAPHIC AREAs that describe the polygons that form the carriageway. TOPOGRAPHIC AREAs are part of the OS MasterMap layer and not the Road network.
- The ROAD feature records the road name or number. A ROAD LINK may belong to more than one ROAD – e.g. separately for the Welsh name, English name, or to specify the DfT Road Number (e.g. A3 or B261).
- Although formally the RN model represents the associations between a node and link as two DIRECTED NODE associations (one negative, and one positive), for clarity, we show these as two separate “from” and “to” associations to an explicit DIRECTED (ROAD) NODE element - which may have attributes in its own right. A DIRECTED (ROAD) NODE may have a GRADE SEPARATION attribute to indicate that the ends are at different levels.
- An INFORMATION POINT describes arbitrary labels of the road network, such as motorway junction numbers.

Geometry of Road Features:

- ROAD LINK features have POLYLINE geometry; ROAD NODE features have POINT geometry.
- ROAD NODE features are coincident with the end of all ROAD LINKs and represent either (i) a road intersection; (ii) the start or end of a carriageway; (iii) the start or end of a one way section, or; (iv) the point where a road name or number changes.

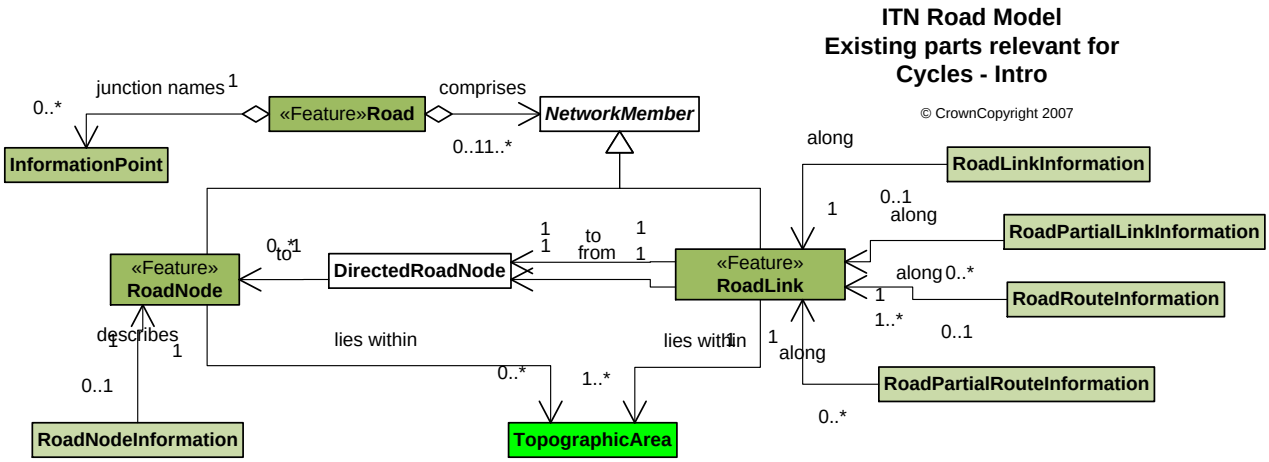


Figure 13-1 Diagram of Overview of base ITN RN Road main elements

Road Routing Features:

Five different types of ROAD ROUTING INFORMATION (RRI) feature can be associated with NETWORK MEMBERs to specify additional constraints on all or part of their length that relate to their use in routing by trip planners.

- ROAD LINK INFORMATION features describe properties that apply to the whole ROAD LINK regardless of direction, for example “no access for unauthorised vehicles”.
- ROAD PARTIAL LINK INFORMATION features describe properties that apply to part of the ROAD LINK regardless of direction, for example restrictions on use of part of a road to particular times. Start & end coordinates and a distance are used to delineate the partial link.
- ROAD ROUTE INFORMATION features describe properties that apply over a whole link in a particular direction of travel, for example “one-way”.
- ROAD ROUTE INFORMATION features describe properties that apply to a particular direction of travel of a whole link, for example “no access for unauthorised vehicles”.
- ROAD ROUTE INFORMATION features describe properties that apply to part of a link in a particular direction of travel, for example “one way” over just part of a road link.
- ROAD NODE INFORMATION features describe properties that apply at an intersection, for example a height restriction at a bridge.

More than one routing element may be specified and RN sets out rules for their precedence.

Shared Properties of the Road Network

Figure 13-2 elaborates Figure 13-1 to show common properties of the Road Network FEATUREs and the similarities between them.

Although in the ITN RN documentation the common attributes are typically explicitly listed for each element, rather than say being factored out into shared supertypes, many of the attributes are common to more that one element and in a conceptual model can be expressed more concisely using a type hierarchy such as that shown in Figure 13-2.

Thus FEATUREs can be considered to have a shared hierarchy of common properties as follows:

Feature Hierarchy:

- FEATUREs share common LIFE CYCLE management attributes such as version and change dates and have a CHANGE HISTORY.
- ROAD LINKs are types of LINK FEATURE, and ROAD NODEs are types of NODE FEATURE. ROADs, LINK FEATUREs, and NODE FEATUREs are all NETWORK MEMBERs. Thus ROADs, ROAD LINKs, ROAD NODEs are all types of FEATURE.

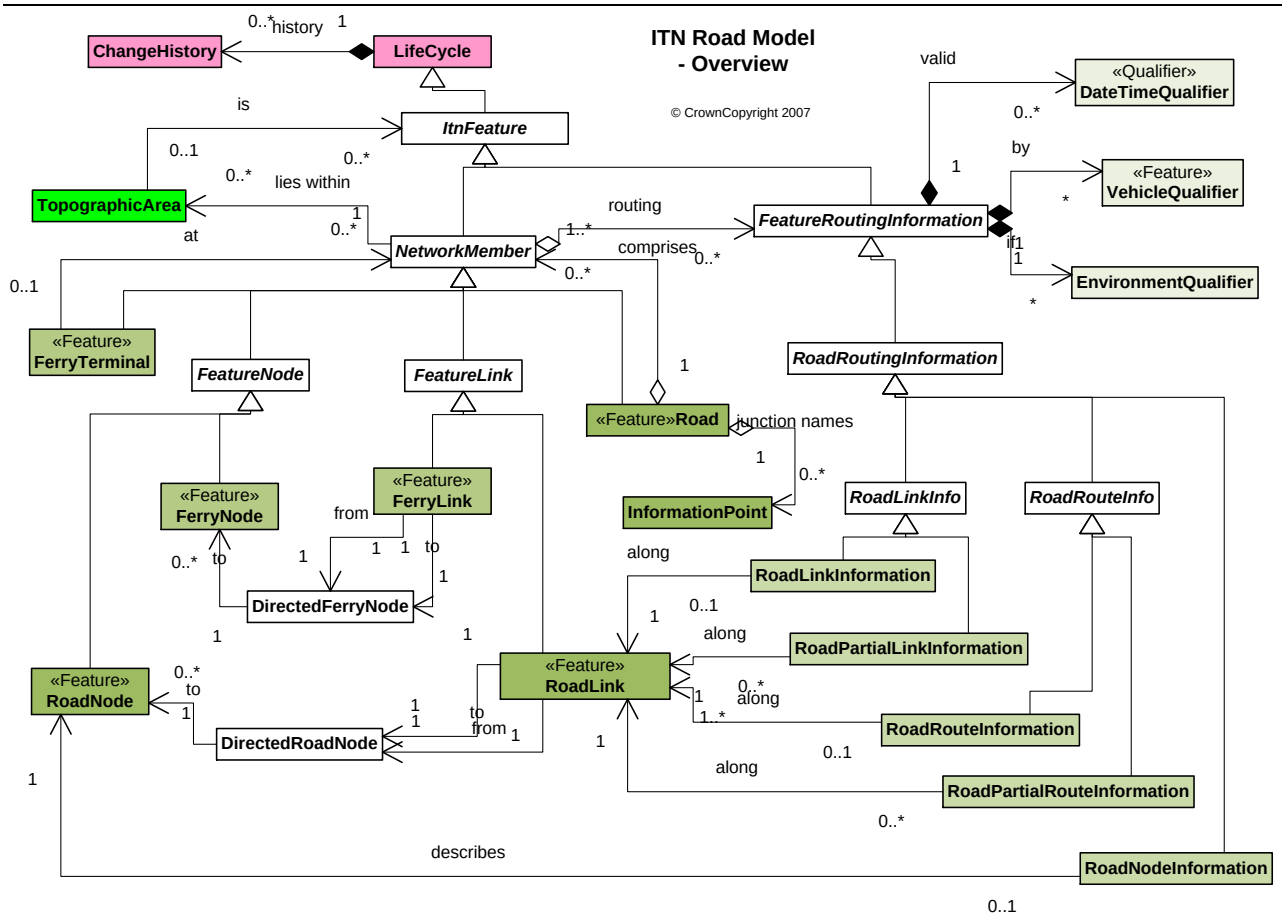


Figure 13-2 UML Diagram of Overview of Existing ITN RN Road main elements

Routing Feature Hierarchy:

Similarly, ROUTING INFORMATION elements can be considered to have a shared hierarchy of common properties as follows:

- ROAD LINK INFORMATION and ROAD PARTIAL LINK INFORMATION share properties as subtypes of an abstract ROAD LINK INFO type.
- ROAD ROUTE INFORMATION and ROAD PARTIAL ROUTE INFORMATION share properties as subtypes of an abstract ROAD ROUTE INFO type.
- ROAD LINK INFO and ROAD ROUTE INFORMATION and ROAD NODE INFORMATION share properties as subtypes of an abstract ROAD ROUTING INFORMATION element.
- All ROAD ROUTING INFORMATION elements are types of FEATURE ROUTING INFORMATION.
- All ROAD FEATURE ROUTING INFORMATION elements are types of FEATURE.

Road Feature Qualifier:

The ROAD ROUTING INFORMATION elements can be given any of three different types of QUALIFIER, to specify the nature of the link and constraints on routing over all or part of the ROAD LINK or ROAD NODE.(See [ITN1] for further details).

1. A DATE TIME QUALIFIER: specifies a temporal scope such as day type (day of week), time band, etc.
2. A VEHICLE QUALIFIER specifies vehicle use constraints, such as the types of vehicles which may use the part of the road described by the link or partial link.
3. An ENVIRONMENTAL QUALIFIER specifies environmental properties and constraints on use such as direction of travel, etc.

Road Network Attributes

Figure 13-3 elaborates Figure 13-1 further. In particular, it introduces the data attributes, some of which are specific to a particular type of element; others of which, such as version or geometry, can be regarded as inherited properties from one or more of common abstract super-types such as FEATURE, FEATURE NODE, FEATURE LINK, LIFECYCLE, etc.

- ROADS can be given a name and an overall bounding box.
- ROAD LINKs can be given a Road Type and a Road Nature.
- The DIRECTED NODE associations used to connect a ROAD NODE to a ROAD LINK can be given a GRADE SEPARATION to indicate a difference in level.

- The SUBSECTION attributes of ROAD PARTIAL LINK INFORMATION and ROAD PARTIAL ROUTE INFORMATION allow the qualifier to be associated with part of a ROAD LINK.
- The POINT attributes of ROAD LINK INFORMATION and ROAD ROUTE INFORMATION allow the exact position of a qualifier to be indicated.

The detailed structure of the ROAD ROUTING INFORMATION QUALIFIERs is shown later below.
As in Figure 13-2 , in the logical representation of RN, we make use of two additional abstract super types – FEATURE NODE and FEATURE LINK – that allow common properties of NODEs and LINKs respectively to be shared with those of the PATH Model.

Note that the CycleNetwork theme is added by the CNM, and the altitude and profile are also additions

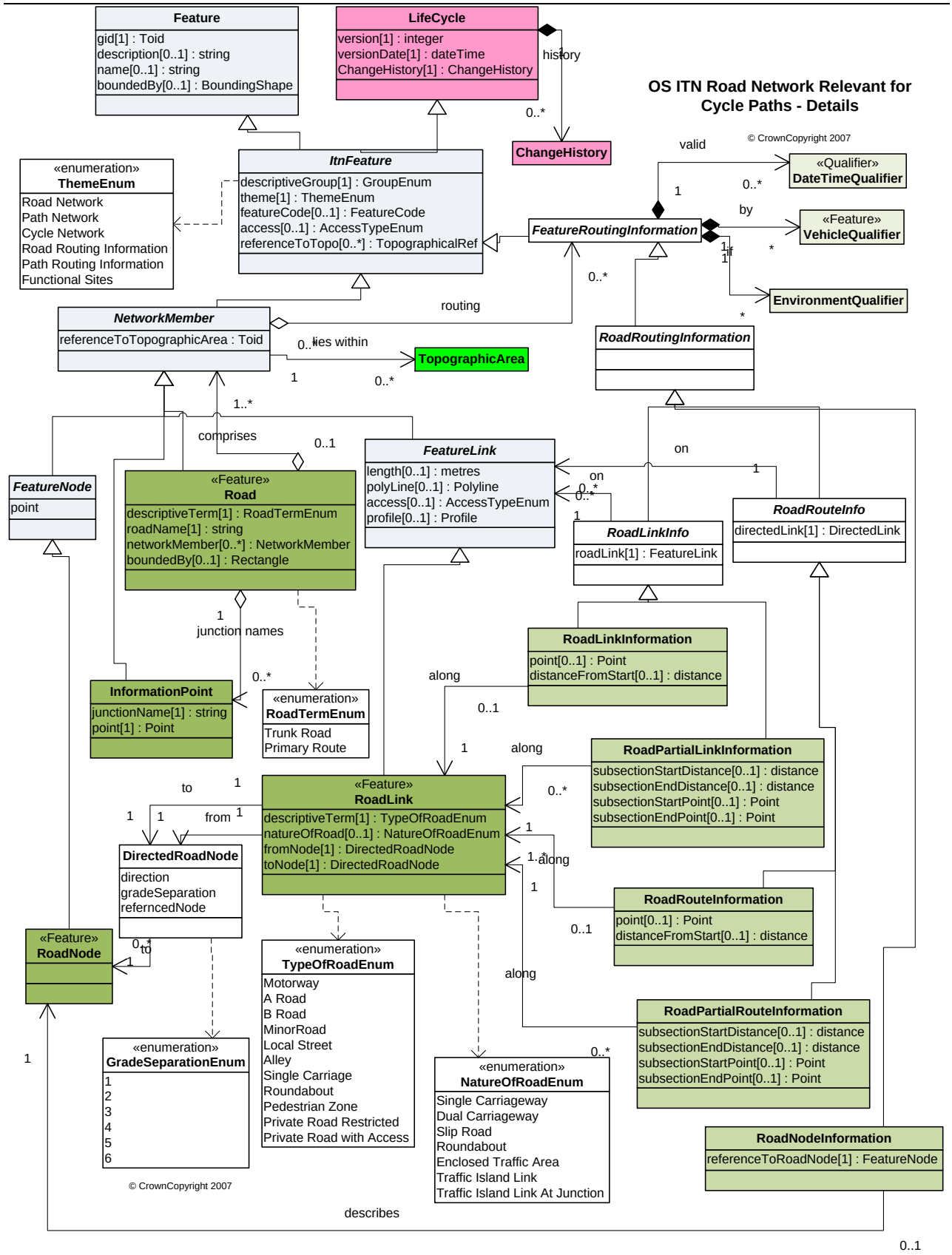


Figure 13-3 UML Diagram of ITN RN Road attributes

Date Time Qualifier

Figure 13-4 shows an ITN DATE TIME QUALIFIER, which is used to specify when a particular ROAD ROUTING INFORMATION applies. It can specify a day of week, holiday day type, hour of day, etc. see [ITN1],
There are two types of period:

- NAMED PERIOD A period given only a textual description.
- SPECIFIED PERIOD: A period further described by additional attributes.

SPECIFIED PERIOD may be specified as to three different aspects:

- DAY: A day type such as Monday, Market Days, etc.
- DATE RANGE: A range of days.
- NAMED TIME: A timeband.

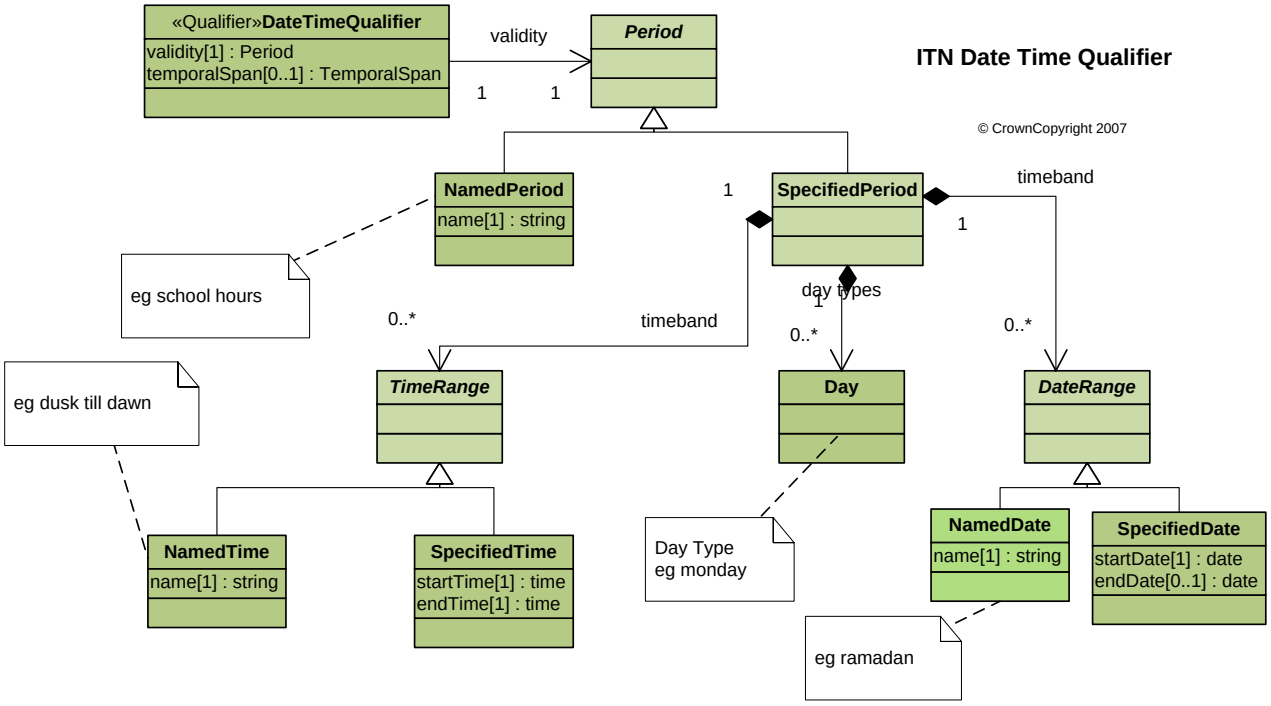


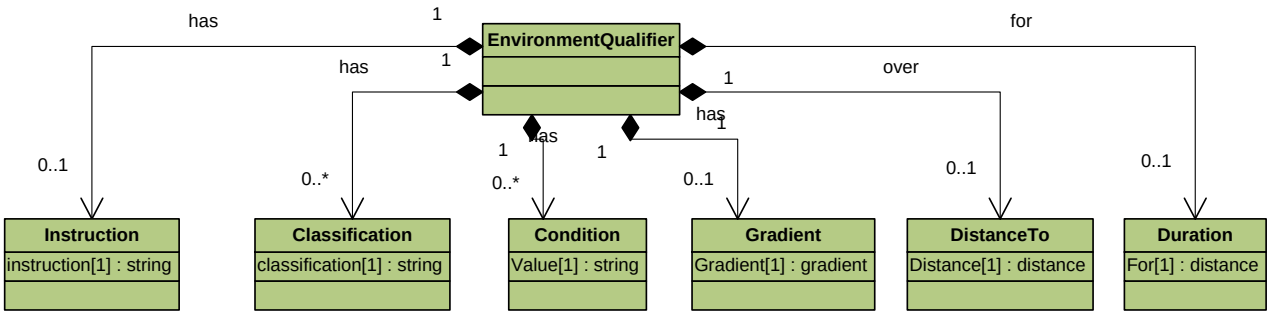
Figure 13-4 UML Diagram of ITN Date & Time Qualifier

Environment Qualifier

Figure 13-5 shows the RN ENVIRONMENTAL QUALIFIER which is used in conjunction with a RRI to specify the directions of use, gradient, etc along a ROAD LINK or at a ROAD NODE. See [ITN1].

- INSTRUCTION – Whether a turn can be made. Relevant for Cycling Routing on roads.
- CLASSIFICATION – Further description of the Feature, e.g. as a bridge, etc
- CONDITION can describe an arbitrary condition, e.g. “Deer crossing”. Can be relevant for Cycling.
- GRADIENT - The inclination of the Road or Path. Relevant for Cycling Routing.

- DISTANCE TO – Allows an indication as to how far it is to a qualifier value.
- DURATION – Allows an indication of how long the qualifier value continues, e.g. two miles



ITN Road Model
Base Environmental Qualifier

Figure 13-5 UML Diagram of ITN RN Environmental Qualifier

Vehicle Qualifier

Figure 13-6 shows the RN VEHICLE QUALIFIER which is used to specify to which types of vehicle a RRI applies, etc. see [ITN1]. Certain of these attributes are of relevance for describing a route for a cycle trip planner and the values may be of use for describing shared use of ROAD LINKs and in CNM PATH LINKs.

Only certain of the RN elements are likely be relevant for cycle routing, in particular:

- VEHICLE TYPE – The kind of traffic allowed on the FEATURE, e.g. buses, cycles.
- VEHICLE USE – The circumstances of access: e.g. school bus, emergency, etc.

Most other VEHICLE attributes, such a HEIGHT & WEIGHT restrictions and LOAD type, are not of direct relevance for cycle routing, though they might be used indirectly, for example, to derive the attractiveness of a lane.

However for the most part the CNM adds cycle vehicle specific constraints using a LANE QUALIFIER and/or a PATH ADVISORY QUALIFIER.

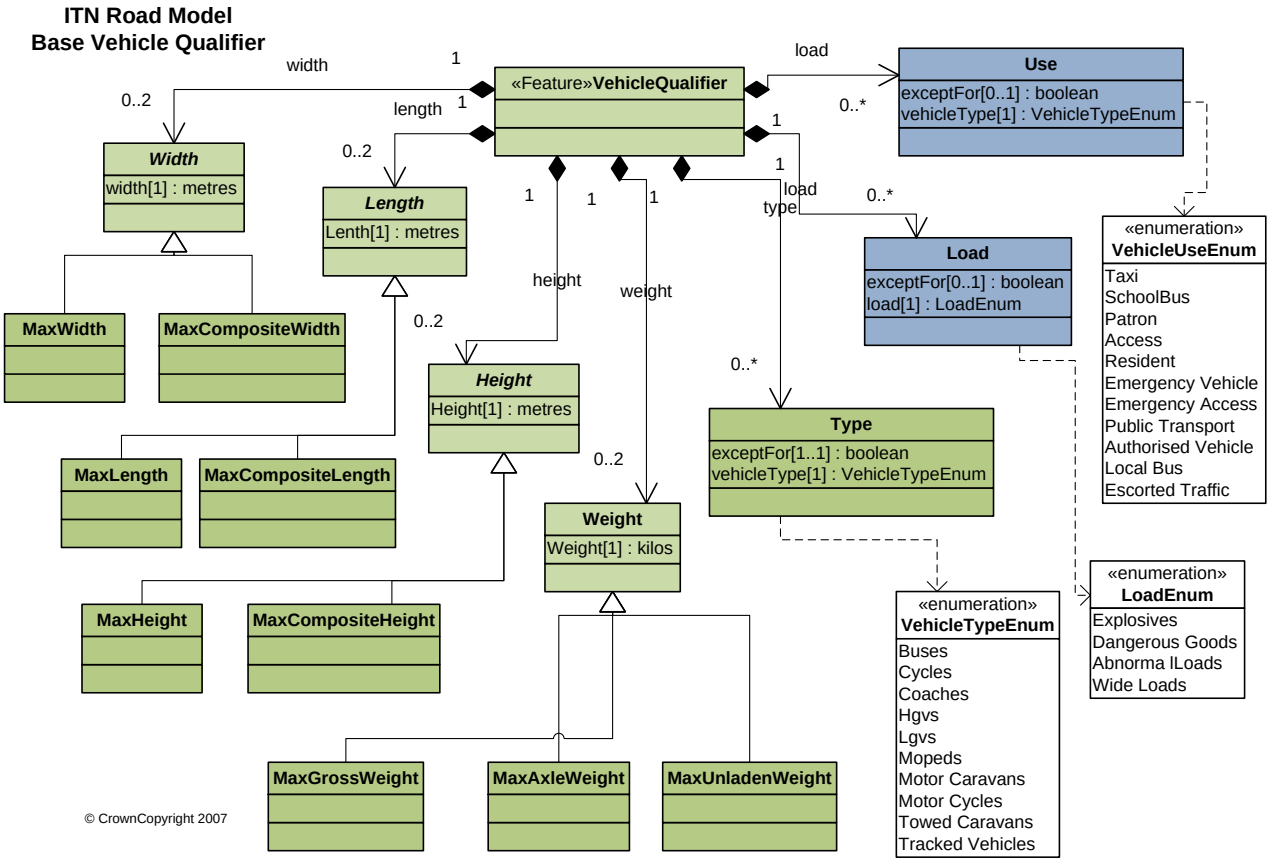


Figure 13-6 UML Diagram of Vehicle Qualifier

13.2. Base Pedestrian Network

The Pedestrian Network describes footpaths, bridleways and other paths that are not described by the ITN road network. See [PN1] for details of which paths are considered separate.

Pedestrian Network Introduction

The ITNPedestrian Network model is summarised in Figure 13-7.

PN Features:

- PATHs are made up of one or more PATH LINKs, connecting at PATH NODEs at each end.
- The association between a PATH LINK and a PATH NODE is made by a DIRECTED (PATH) NODE: the origin end is marked as negative, the destination and positive, and both may have a GRADE SEPARATION attribute.
- PATH NODES may be connected to the road network using CONNECTING LINKs. Each CONNECTING LINK connects a PATH or ROAD NODE with a PATH or ROAD NODE. CONNECTING LINKs are not usually given GEOMETRY.
- EACH CONNECTING NODE references a FEATURE NODE through the *Network Location* relationship: either a PATH NODE or a ROAD NODE.

PN Geometry:

- PATH LINKs have POLYLINE geometry; PATH NODEs have POINT GEOMETRY.

PN Routing Features:

- PATH LINKs may have PATH LINK INFORMATION elements to describe routing attributes.

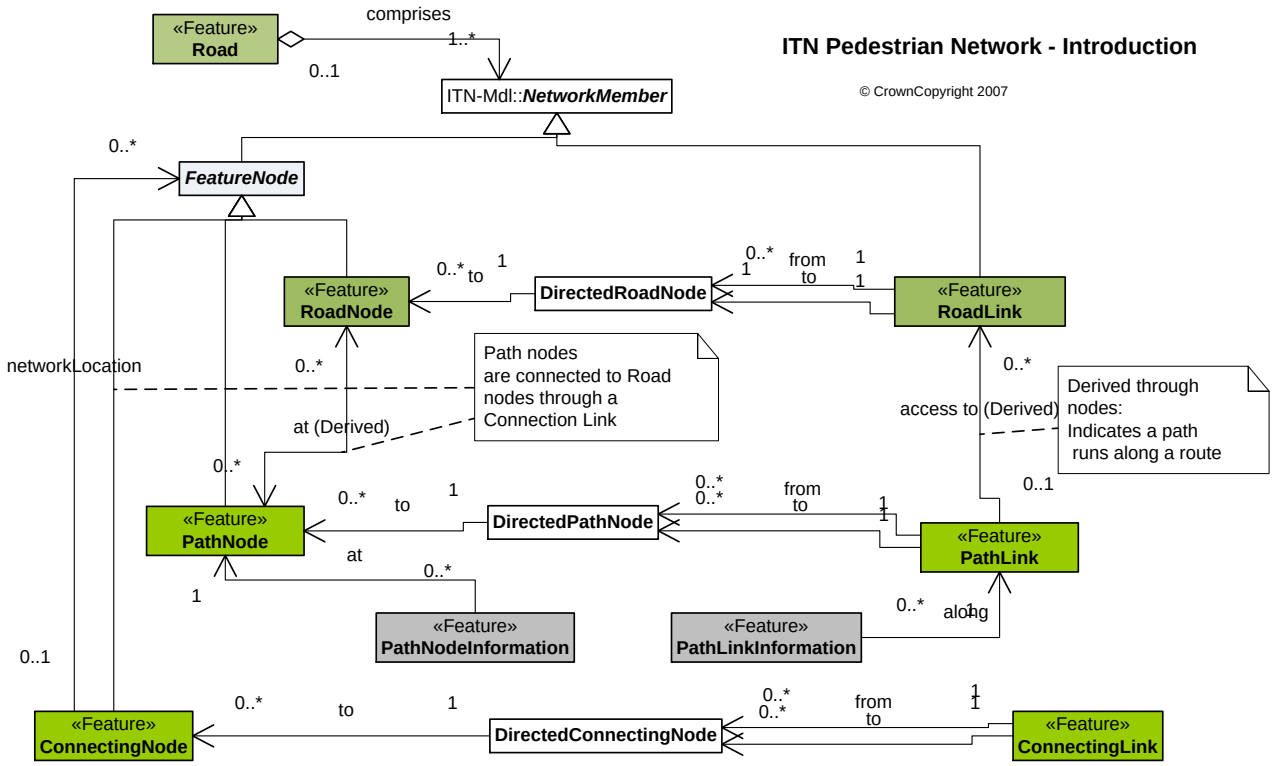


Figure 13-7 UML Diagram of Introduction to ITN PN Network

Pedestrian Network Overview

The Pedestrian Network model introduced in Figure 13-7, is elaborated in Figure 13-8 to show ITN ACCESS LINKS and NODES and FUNCTIONAL SITES.

- As for the ITN RN, the various types of node and link can be considered as types of FEATURE, FEATURE LINK, FEATURE NODE, etc, which share common properties through the same abstract type hierarchy as for RN.
- Physical features such as PATH NODEs and PATH LINKs may be associated with a TOPOGRAPHIC AREA that describes the polygons that form the pathway.
- FUNCTIONAL SITEs represent Points of Interest, car parks, stations, bus stops, other access points to public transport, public open spaces, and other places with designated entrances and exits.
- ACCESS NODEs designate points of entry to a FUNCTIONAL SITE to which the path and road networks may connect using CONNECTING LINKs. An ITN ACCESS LINK connects an ACCESS NODE to a FUNCTIONAL SITE.
- For stations and other complex transport interchanges, ACCESS NODES correspond to ENTRY points in the NaPTAN/ IFOPT model and can be referenced.

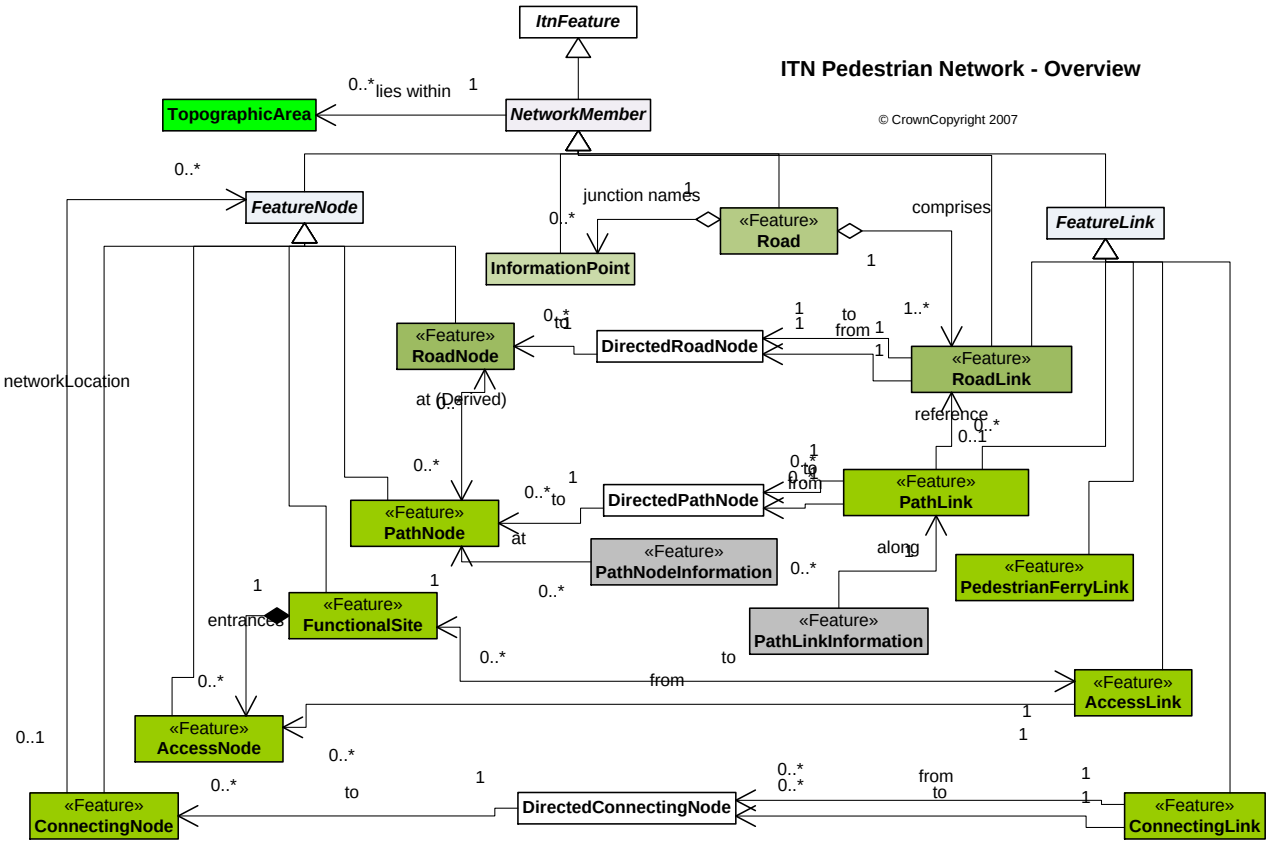


Figure 13-8 UML Diagram of overview of ITN PN Network

Pedestrian Network Attributes

Figure 13-9 elaborates Figure 13-8 to show more detailed properties of the Pedestrian Network, In particular it introduces the data attributes, some of which are specific to particular types of feature, others of which. such as version or GEOMETRY, can be regarded as inherited properties from one or more of common abstract super types such as FEATURE, FEATURE LINK, LIFECYCLE, etc.

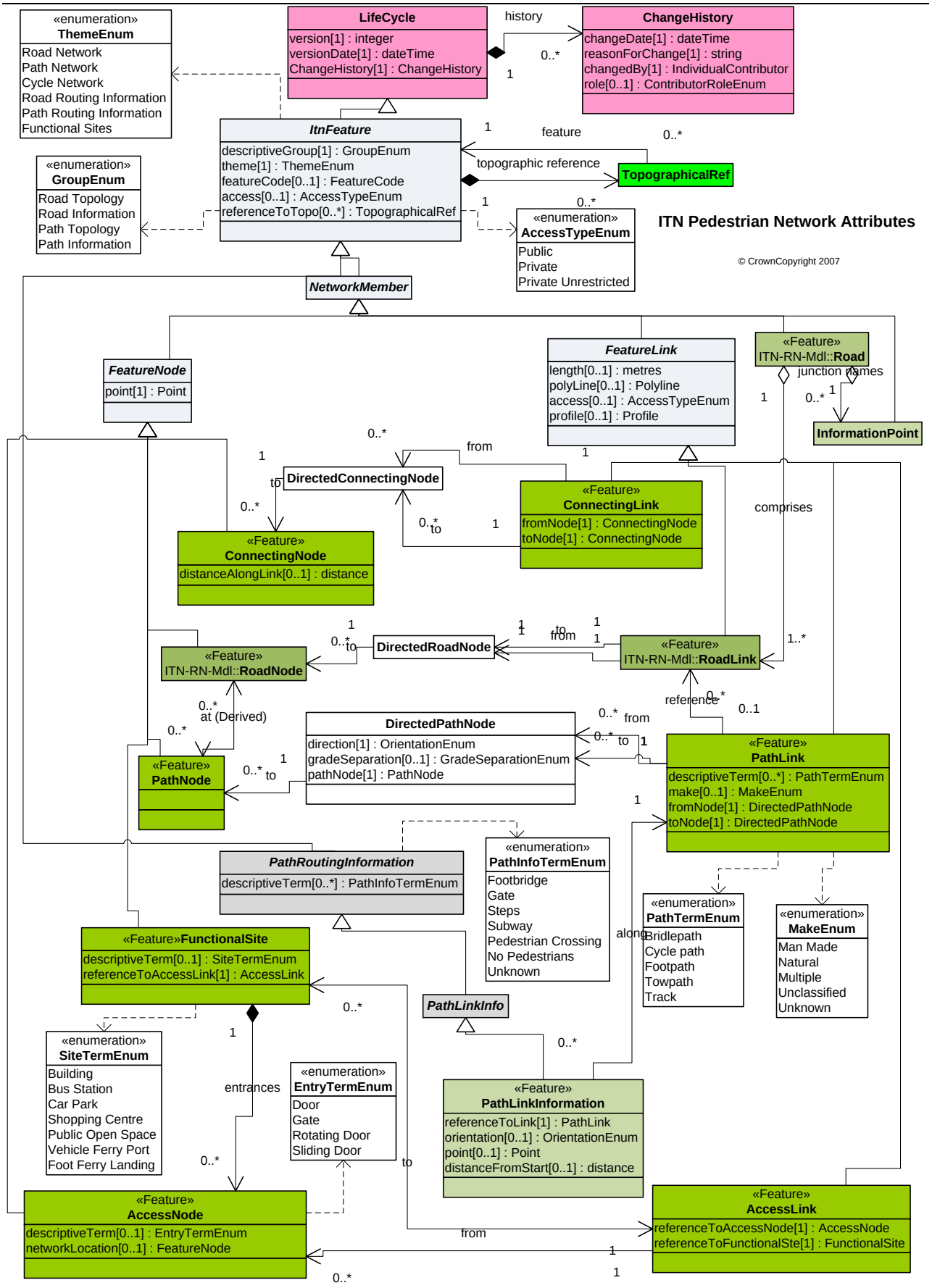


Figure 13-9 UML Diagram of PN attributes

13.3. Data types

The following diagrams summarise the data types use din CNM.

.

GML data types

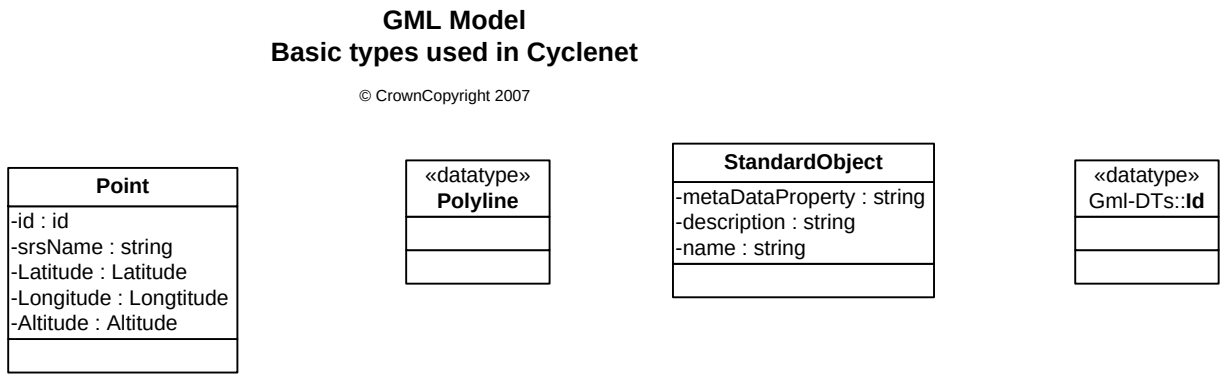


Figure 13-10 GML base data types used in CNM

OS ITN data types

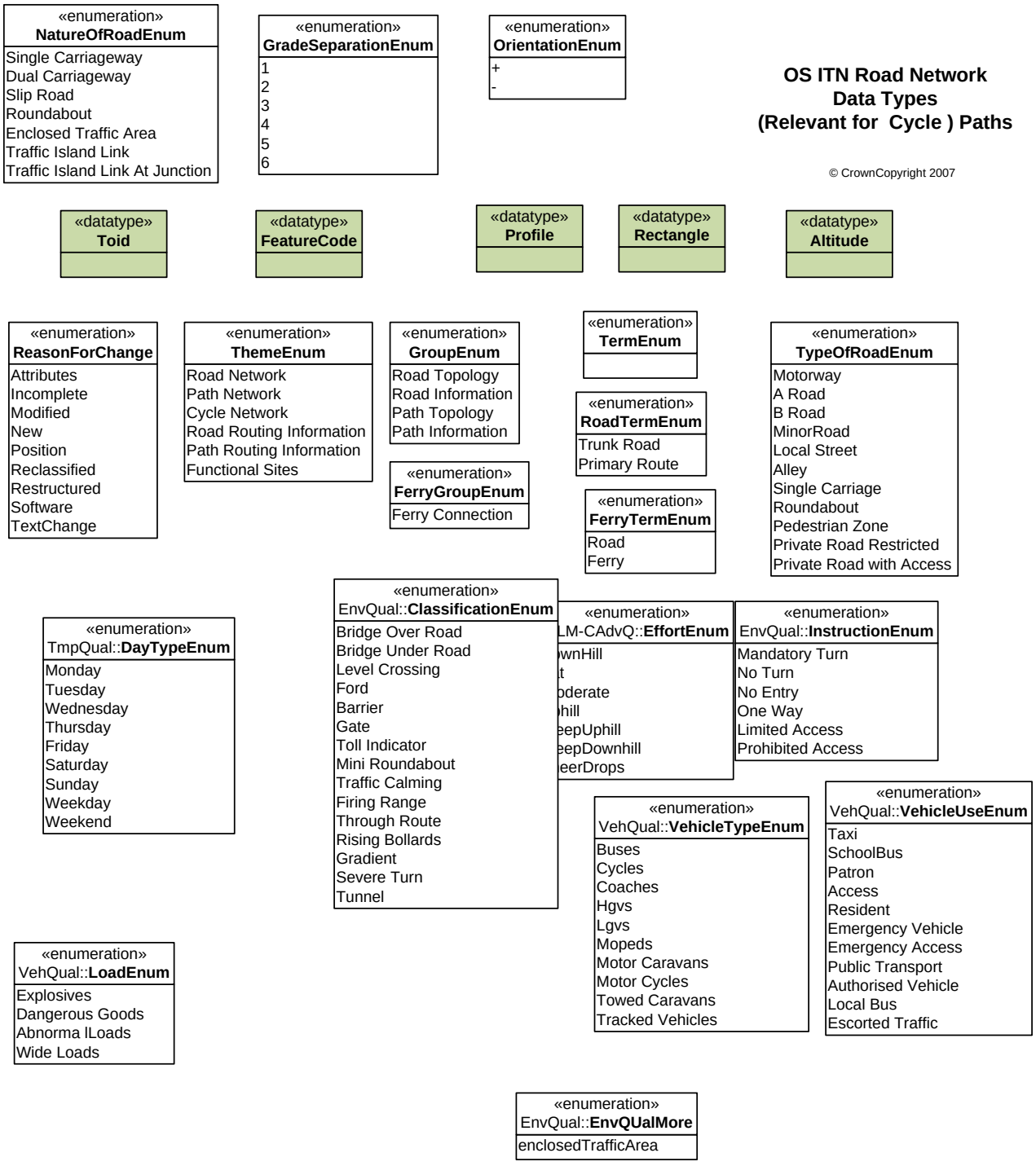
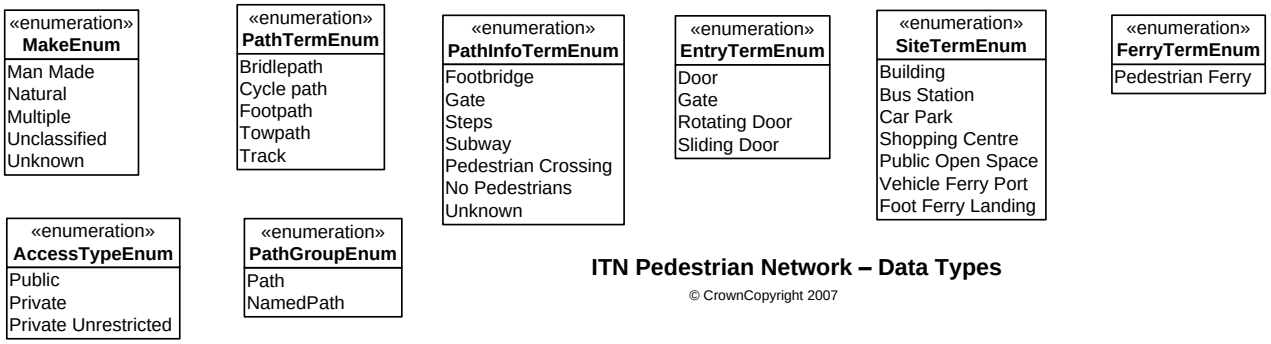


Figure 13-11 OS ITN data types used in CNM

ITN PN data types



CNM data types

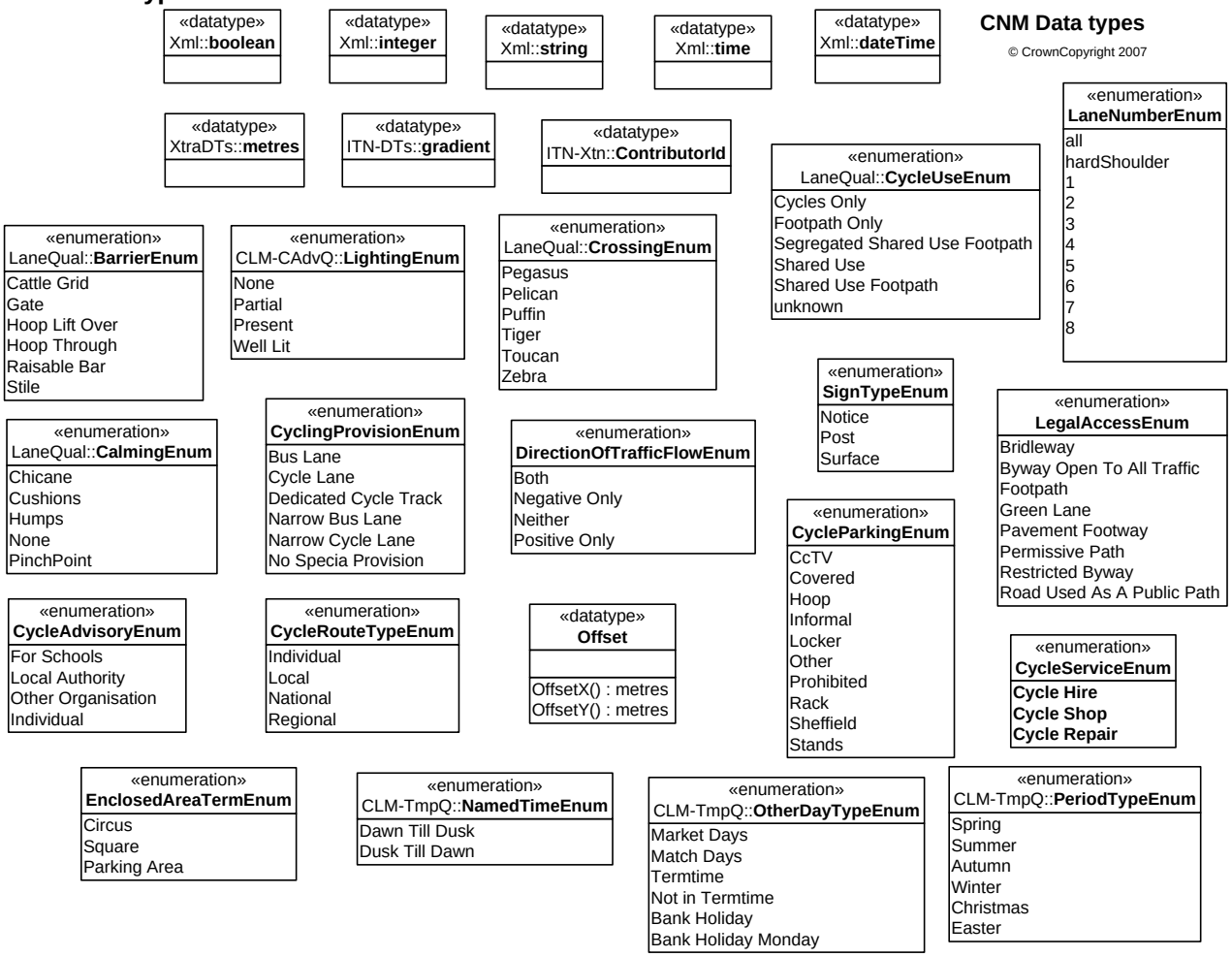


Figure 13-12 CNM data types

14. ANNEX B - TABLE OF EQUIVALENT TERMS

Table 14-1 Compares terms for equivalent concepts in CNM, ITJN RN, PN, GDF, Transmodel, IFOPT and NaPTAN.

CNM	ITN RN & PN	GDF	Transmodel/IFOPT	NaPTAN
RoadLink	***RoadLink***	***RoadElement***	ROAD ELEMENT	--
RoadNode	***RoadNode***	***Junction***	JUNCTION	--
FerryLink	***FerryLink***	***FerryLink***		--
FerryNode	***FerryNode***	***FerryNode***		--
PathLink	***PathLink***	***??***	PATH LINK	--
PathNode	***PathNode***	***??***	ABSTRACT STOP PLACE SPACE	--
OffsetPathLink	***--***	***--***	--	--
OffsetPathNode	***--***	***--***	--	--
PedestrianFerryLink	***PedestrianFerryLink***	***??***	--	--
EnclosedTrafficArea	***--***	***EnclosedTrafficArea***	---	-
Road	***Road***			--
AggregatedWay	***---***	***AggregatedWay***	---	--
(RRI, PRI + Manoeuvrability)	***--***	***Manoeuvre***	MANOEUVRE	
ConnectingLink	***ConnectingLink***	--	--	--
ConnectingNode	***ConnectingNode***	--	--	--
--	***--***	***--***	ACCESS LINK	
AccessLink	***AccessNode***	***??***	ACCESS PATH LINK (IFOPT)	--
AccessNode	***AccessNode***	***??***	STOP PLACE ENTRANCE:	StopPoint (Entrance)
--	***--***	***??***	CONNECTION LINK	--
--	***--***	***??***	CONNECTION NODE	--
FerryTerminal	***FerryTerminal***	***??***		StopPoint
FeaturedSIte	***FeaturedSIte***	***ComplexFeature***	COMPLEX FEATURE, • STOP PLACE • POINT OF INTEREST • PARKING	StopPoint (Access-Area)
Service	***--***	***--***	LOCAL SERVICE	--
DirectedNode	***DirectedNode***	***--***	(PATH LINK)	--
(GradeSeparation)	***(GradeSeparation)***	***--***	LEVEL	--
RoadRoutingInformation	***RoadRoutingInformation***	--	--	
RoadLinkInformation	***RoadLinkInformation***	***--***	--	
RoadPartialLinkInformation	***RoadPartialLink-Information***	***(Stop Point Along Road)***	--	
RoadRouteInformation	***RoadRouteInformation***	***(Route Point Along Road)***	--	
RoadPartialRouteInformation	***RoadPartialRoute-Information***	***??***	--	--
RoadNodeInformation	***RoadNodeInformation***	***??***	--	
PathRoutingInformation	***--***	***??***	--	--
PathLinkInformation	***PathLinkInformation***	***??***	--	--
PathPartialLinkInformation	***--***	***??***	--	--
RoadRouteInformation	***--***	***??***	--	--
PathNodeInformation	***--***	***??***	--	--
LaneInformation	***--***	***??***	--	--
CycleInformation	***--***	***--***	--	--
DateTimeQualifier	***DateTimeQualifier***	***??***	VALIDITY CONDITION	Validity
Day	***Day***	***DayType***	DAY TYPE	DayType
TimeRange	***TimeRange***	***??***	TIME BAND	--
EnvironmentalQualifier	***EnvironmentalQualifier***	***??***	--	--
VehicleQualifier	***VehicleQualifier***	***??***	--	--
LaneQualifier	***--***	***??***	--	--
PathAdvisoryQualifier	***--***	--	--	--
--	***--***	***Limitation***	ACCESSIBILITY LIMITATION	--
--	***--***	***--***	ACCESSIBILITY ASSESSMENT	--
--	***--***	***--***	CHECKPOINT	--
NavigationPath	***--***	***--***	NAVIGATION PATH	--

Table 14-1 Comparison of Tables

15. ANNEX C - TRANSPORT DIRECT CYCLE PLANNER DATA REQUIREMENTS

The CNM provides a model to describe a cycle network. This model can be populated incrementally to varying levels of detail. For example the same model can be used for areas where extensive surveying has been carried out to collect detailed cycling data, and ones where data is created from existing path and road data.

This section provides a list of the Transport Direct Cycle Planner data requirements. Each feature is give a priority of **M**ust, **S**hould, or **C**ould have. The **M**ust have requirements are considered a minimum set of data that are required to produce reliable cycle trip planning.

The potential data source of each CNM element is also provided, currently only three data sources are considered, RN, PN and Other. 'Other' represents other unspecified data sources for example professional organisations, Local Authorities and community members, these data are used to complete and extend the RN and PN datasets. ITN indicates both RN & PN.

See section 6.6 for a discussion of possible levels of completeness of a cycle data set. It is envisaged that the CNM data set supplied for the TDP will be combined with Road and Path data sets: thus Option 1 from 6.6 (supplying '*Only the parts of the Cycle Network that have additional attributes for Cycling')* will suffice for Transport Direct Cycle Planner data requirements.

CNM Element Group	CNM Element	Model	Data Source	Priority M/S/C	Data collection notes
Road Network	***RoadLink***	RN	RN	*M*	ITN assumed complete, with Geometry
	RoadNode	RN	RN	*M*	ITN assumed complete
	Road	RN	RN	*M*	ITN assumed complete, with Geometry
	InformationPoint	RN	RN	*S*	ITN assumed complete
	FerryLink	RN	RN	*S*	ITN assumed complete, with Geometry
	FerryNode	RN	RN	*S*	ITN assumed complete
	FerryTerminal	RN	RN	*S*	ITN assumed complete
Path Network	***PathLink***	PN	*PN, Other*	*M*	Existing PN needs additions
	PathNode	PN	*PN, Other*	*M*	Existing PN needs additions
	PedestrianFerryLink	PN	*PN, Other*	*M*	Existing PN needs additions
	ConnectingLink	PN	*PN, Other*	*M*	In addition to existing PN. These represent the connection between PN and ITN are unlikely to be complete in PN, all connections where transit on bike is available needs to be modelled.
	ConnectingNode	PN	*PN, Other*	*M*	
	AccessLink	PN	*PN, Other*	*S*	For example, access to points of interest – destinations In addition to PN features
	AccessNode	PN	*PN, Other*	*S*	For example access to points of interest – destinations In addition to PN features
	FunctionalSite	PN	*PN, NaPTAN, Other*	*S*	Such as destinations Existing PN needs further coverage, other sources e.g. PointX, NaPTAN.
Cycle Network	***OffsetPathLink***	CNM	*PN, Other*	*M*	Can be populated from Road & Cycle Links. Should reference the originating link
	OffsetPathNode	CNM	*PN, Other*	*M*	Can be populated from Road & Cycle Nodes. Should reference the originating node
	PathNetwork	CNM	*PN, Other*	*M*	Provides a container for Cycle data
	CycleInformation	CNM	*Other*	*S*	New feature
	AggregatedWay	CNM	*PN, Other*	*S*	In addition to existing PN aggregated ways with Sustrans, Regional and Local Cycle routes

	EnclosedTrafficArea	CNM	*ITN RN, Other*	*C*	ITN does not have yet
CNM Features	***FeatureInformation***	CNM	*Other*	*C*	New feature
	FeatureAlias	CNM	*Other*	*C*	New feature
	PlaceReference	CNM	*Rn, PNOther*	*S*	ITN topographic refernce
	CycleFunctionalSite	CNM	*Other*	*S*	New feature
Road Routing	***RoadRoutingInformation***	RN	RN	*M*	ITN assumed complete
	RoadLinkInformation	RN	RN	*M*	ITN assumed complete
	RoadPartialLinkInformation	RN	RN	*M*	ITN assumed complete
	RoadRouteInformation	RN	RN	*M*	ITN assumed complete
	RoadPartialRoute-Information	RN	RN	*M*	ITN assumed complete
	RoadNodeInformation	RN	RN	*M*	ITN assumed complete
Path Routing	***PathLinkInformation***	PN	*PN, Other*	*M*	Existing PN needs further coverage
	PathPartialLinkInformation	CNM	*PN, Other*	*M*	Used to associate the routing attributes to network, details below.
	PathRouteInformation	CNM	*PN, Other*	*M*	New feature
	PathPartialRouteInformation	CNM	*PN, Other*	*M*	New feature
	PathPartialRouteInformation	CNM	*PN, Other*	*M*	New feature
	PathNodeInformation	CNM	*PN, Other*	*C*	New feature
	LaneInformation	CNM	*PN, Other*	*C*	New feature
Qualifiers	***DateTimeQualifier***	RN	*RN, Other*	*See details*	In addition to PN/ITN
	Environmental Qualifier	RN	*RN, Other*	*See details*	In addition to PN/ITN
	VehicleQualifier	RN	*RN, Other*	*See details*	In addition to PN/ITN
	LaneQualifier	CNM	*Other*	*See details*	In addition to PN/ITN
	PathAdvisoryQualifier	CNM	*Other*	*See details*	In addition to PN/ITN
Vehicle-Qualifier	***Type***	RN	RN	*M*	ITN assumed complete
	Use	RN	RN	*C*	ITN assumed complete
	Load	RN	RN	--	Not relevant
	Max Width	RN	RN	*C*	ITN assumed complete
	Max Length	RN	RN	*C*	ITN assumed complete
	Max Height	RN	RN	--	Not relevant
	Weight	RN	RN	--	Not relevant
DateTime-Qualifier	***Day***	RN	RN, *Other*	*S*	For example path through park only open during daylight In addition to PN/ITN
	NamedDate	RN	RN, *Other*	*C*	
	SpecifiedDate	RN	RN, *Other*	*S*	
	NamedPeriod	RN	RN, *Other*	*C*	
	SpecifiedTime	RN	RN, *Other*	*S*	
	NamedTime	RN	RN, *Other*	*C*	
	DayType	CNM	Other	*S*	Structured data
	OtherDayType	CNM	Other	*S*	
	PeriodType	CNM	Other	*S*	
Environ-mental-Qualifier	***Instruction***	RN	RN, *Other*	*M*	Routing Information e.g. one way
	Classification	RN	RN, *Other*	*M*	Descriptive of Route e.g. tunnel
	DistanceTo	RN	RN, *Other*	*M*	Must be present when relevant
	Condition	RN	RN, *Other*	*C*	
	Duration	RN	RN, *Other*	*C*	
	Gradient	RN	*Other*	*S*	Not collected but sourced from other datasets or projects
Lane-Qualifier	***Direction of Use***	CNM	*Other*	*M*	New feature/attribute
	Average Width	CNM	*Other*	*C*	New feature/attribute
	TrafficCalming	CNM	*Other*	*C*	New feature/attribute
	CalmingAvoidableByCycle	CNM	*Other*	*S*	New feature/attribute
	Surface	CNM	*Other*	*S*	New feature/attribute
	CyclingProvision	CNM	*Other*	*M*	New feature/attribute
	CycleUse	CNM	*Other*	*M*	New feature/attribute
	Barrier	CNM	*Other*	*C*	New feature/attribute
	Crossing	CNM	*Other*	*S*	New feature/attribute
	AdvancedStopLine	CNM	*Other*	*C*	New feature/attribute
	TrafficLight	CNM	*Other*	*C*	New feature/attribute

	Signage	CNM	*Other*	*C*	New feature/attribute
	TrafficSpeed	CNM	*Other*	*C*	Not collected but sourced from other datasets or projects
	TrafficVolume	CNM	*Other*	*C*	Not collected but sourced from other datasets or projects
Path-Advisory-Qualifier	***Quietness***	CNM	*Other*	*S*	New feature/attribute
	Recommendation	CNM	*Other*	*S*	New feature/attribute
	Effort	CNM	*Other*	*C*	*Other*
	Congestion	CNM	*Other*	*C*	*Other*
	Lighting	CNM	*Other*	*S*	New feature/attribute
	PersonalSafety	CNM	*Other*	*C*	New feature/attribute
Cycling-Manoeuvrability	***Instruction***	CNM	*Other*	*S*	New feature/attribute Can be derived in some cases. In other cases needs manual augmentation.
	FurtherInstruction	CNM	*Other*	*S*	New feature/attribute
	Manoeuvrability	CNM	*Other*	*S*	New feature/attribute
All Features	***Toid***	CNM	*ITN, Other*	*M*	Identifier
	Descriptive Grouping	CNM	*ITN, Other*	*S*	Name where appropriate
	Theme	CNM	*ITN, Other*	*M*	Meta data -Cycle Network
	Descriptive Term	CNM	*ITN, Other*	*M*	Type where appropriate
All Features Life Cycle	***VersionNumber***	RN	*ITN, Other*	*M*	ITN assumed complete, add with new data
	VersionDate	RN	*ITN, Other*	*M*	ITN assumed complete, add with new data
	ChangeDate	RN	*ITN, Other*	*M*	ITN assumed complete, add with new data
	ReasonForChange	RN	*ITN, Other*	*M*	ITN assumed complete, add with new data
Community	***ChangedBy***	CNM	*ITN, Other*	*M*	ITN New feature/attribute assumed complete, add with new data
	Contributor	CNM	*ITN, Other*	*M*	New feature/attribute
	SurveyMethod	CNM	*ITN, Other*	*M*	New feature/attribute
	VerificationStatus	CNM	*ITN, Other*	*M*	New feature/attribute
	AllowedUse	CNM	*ITN, Other*	*M*	New feature/attribute
	IprNotes	CNM	*Other*	*C*	New feature/attribute
Feature Information	***InfoLink***	CNM	*Other*	*C*	New feature
	InfoType	CNM	*Other*	*C*	New feature
Contributor	***Id***	CNM	*Other*	*M*	Needed to manage community data
	ContributorType	CNM	*Other*	*M*	Needed to manage community data
	Name	CNM	*Other*	*S*	New feature
	Email	CNM	*Other*	*M*	Needed to manage community data
	AllowPublishEmail	CNM	*Other*	*C*	New feature
	WebSite	CNM	*Other*	*C*	New feature
	Uri	CNM	*Other*	*C*	New feature
Contributor Organisation	***dnfPrefix***	CNM	*Other*	*M*	Needed to manage community data
	OrganisationName	CNM	*Other*	*M*	Needed to manage community data
	Manager	CNM	*Other*	*M*	Needed to manage community data
	ParentOrganisation	CNM	*Other*	*C*	Needed to manage community data
Individual Contributor	***Name***	CNM	*Other*	*M*	New feature
	Organisation	CNM	*Other*	*M*	New feature

Table 15-1 CNM Elements